Bulletin n° 128 Septembre-Octobre 1961

U. R. S. I.

TABLE DES MATIÈRES

IN MEMORIAM

K. S. Krishnan

Le décès soudain de Kariamanikkam S. Krishnan, Président du Comité National Indien de l'U.R.S.I., prive notre Union d'un ami et d'un distingué collègue. C'est le 14 juin que le Dr Krishnan, savant renommé et Directeur du Laboratoire de Physique National de New Delhi, succombait à une crise cardiaque.

Occupant une place de premier rang parmi les scientifiques de son pays, le Dr Krishnan fut élu membre de la Royal Society en 1940 et fut annobli en 1946. Les travaux qu'il publia portent sur l'optique, le magnétisme, l'électronique, la physique et la chimie. Sous sa conduite, le Comité National Indien est devenu un des Comités Nationaux les plus actifs de l'U.R.S.I.

IN MEMORIAM

K. S. Krishnan

The untimely death of Kariamanikkam S. Krishnan, President of the U.R.S.I. Indian National Committee, has deprived our Union of a friend and honored Colleague. Dr. Krishnan, well known scientist and Director of the National Physical Laboratory in New Delhi, died of heart attack on June 14.

Outstanding among the scientists of his country, Dr. Krishnan was honored by election to fellowship of the Royal Society in 1940 and was knighted in 1946. His publications include papers on optics, magnetism, electronics, and the physics and chemistry. Under his guidance the Indian National Committee became one of the most active U.R.S.I. National Committees.

NOUVELLES DE L'U.R.S.I.

Nous avons le plaisir d'annoncer à nos lecteurs que le Président de la Commission V, *Sir Bernard Lovell*, Directeur des Nuffield Radio Astronomy Laboratories de l'Université de Manchester, a été choisi par l'Académie Internationale d'Astronautique comme premier lauréat du *Prix International d'Astronautique Daniel et Florence Guggenheim* ; ce prix sera décerné chaque année à une personne ayant notoirement contribué aux progrès de l'Astronautique durant les cinq années précédentes.

Au nom de l'U.R.S.I., nous présentons nos plus sincères félicitations à Sir Bernard Lovell.

U.R.S.I. NEWS

We have the pleasure to inform our readers that the Chairman of Commission V, *Sir Bernard Lovell*, Director of the Nuffield Radio Astronomy Laboratories of the University of Manchester, has been chosen by the International Academy of Austronautics as first winner of the *Daniel and Florence Guggenheim International Astronautics award* ; this award is to be given each year to a personality who has made outstanding contributions to the progress of astronautics during the preceding five years.

On behalf of U.R.S.I. we present Sir Bernard Lowell with our warmest congratulations.

XIIIe ASSEMBLÉE GÉNÉRALE

Publications

(English text : p. 7)

Les publications ci-après relatives à la XIIIe Assemblée Générale sont sorties de presse et ont été distribuées :

Publications administratives :

Vol. XII :

Compte Rendu de la XIIIe Assemblée Générale.

Fasc. 1. — Commission I : Mesures et Etalons Radioélectriques.

Fasc. 2. — Commission II : Radioélectricité Troposphérique.

Fasc. 8. — Administration et divers.

Monographies :

Monographie sur les Mesures et Etalons Radioélectriques (en français et en anglais).

U.R.S.I. Special Report nº 6 on Radio Observations of the Aurora (avec résumé français).

Sont à l'impression :

Publications administratives :

Vol. XII :

Compte Rendu de la XIIIe Assemblée Générale.

Fasc. 3. — Commission III : Radioélectricité Ionosphérique.

Fasc. 4. — Commission IV : Bruit Radioélectrique d'Origine Terrestre.

Monographies :

U.R.S.I. Special Report nº 7 on the Measurement of Characteristics of Terrestrial Radio Noise.

Monographies consacrées aux Commissions II, III et IV.

XIIIth GENERAL ASSEMBLY

Publications

(French text : p. 6)

The following publications have been issued and distributed :

Administrative Publications :

Vol. XII :

Proceedings of the XIIIth General Assembly.

Part I. — Commission I : Radio Measurements and Standards.

Part II. — Commission II : Radio and Troposphere.

Part VIII. — Administration and Miscellaneous.

Monographs :

Monograph on Radio Measurements and Standards (in English and in French).

U.R.S.I. Special Report nº 6 on Radio Observations of the Aurora (with abstracts in French).

In press :

Administrative Publications :

Vol. XII :

Proceedings of the XIIIth General Assembly.

Part III. — Commission III : Ionospheric Radio.

Part IV. — Commission IV : Radio Noise of Terrestrial Origin.

Monographs :

U.R.S.I. Special Report nº 7 on the Measurement of Characteristics of Terrestrial Radio Noise.

Monographs devoted to Commissions II, III and IV.

Compte Rendu

Le Comité National Français a publié dans l'*Onde Electrique* (nº 411, juin 1961) un compte rendu de la XIIIe Assemblée Générale, divisé comme suit :

Introduction par A. ANGOT, Président du Comité National Français.

Mesures et Etalons Radioélectriques (Commission I), par R. WERTHEIMER, Secrétaire de la Commission I.

Propagation Troposphérique (Commission II), par F. DU CASTEL, Secrétaire de la Commission II.

Ionosphère (Commission III), par D. LÉPÉCHINSKY, Secrétaire de la Commission III.

Perturbations Radioélectriques d'Origine Terrestre (Commission IV), par R. RIVAULT, Secrétaire de la Commission IV.

Mesures de Bruit (Commission IV), par G. FOLDÈS.

Tendances des méthodes de mesure en radioastronomie (Commission V), par E. J. BLUM.

Ondes et Oscillations (Commission VI), par E. MOURIER, R. FORTET, L. ROBIN et J. LOCHARD.

Quelques aspects de l'électronique moderne (Commission VII), par P. GRIVET, M. Y. BERNARD, Secrétaire de la Commission VII, et A. SEPTIER.

COMITÉS NATIONAUX

France

JOURNÉES D'ÉTUDES SUR LES AMPLIFICATEURS PARAMÉTRIQUES

La Commission VII de l'Union Radio Scientifique Internationale a mis à son programme triennal, l'étude de diverses questions, parmi lesquelles figurent les amplificateurs paramétriques. C'est pour faire le point des travaux français dans ce domaine, et susciter de nouveaux développements, que la Faculté des Sciences de Paris (Chaire d'Electronique et de Radioélectricité) et l'Institut National des Sciences et Techniques Nucléaires ont organisé des Journées d'Etudes les 29, 30 et 31 mai 1961. Ces journées étaient placées sous le patronage du Comité National Français de Radioélectricité Scientifique. Cet organisme présidé par le Général Angot, constitue la branche française de l'Union Radio Scientifique Internationale.

Ce colloque était centré sur quatre conférences, prononcées par un spécialiste international, le Professeur H. Heffner, de l'Université de Stanford (Californie) qui avait bien voulu venir exposer les récents progrès dans ce domaine. Les sujets des quatre conférences de M. H. Heffner étaient les suivants :

— le gain et le facteur de bruit dans un amplificateur paramétrique.

— les amplificateurs paramétriques à faisceaux d'électrons.

— les réalisations modernes d'amplificateurs paramétriques à diode.

— possibilités d'avenir des circuits à impédance non linéaire.

Ces quatre conférences, d'une clarté remarquable, ont permis aux auditeurs de faire le point de la question ; mais pour permettre aux non-spécialistes, et spécialement aux étudiants de troisième cycle d'électronique, de bien les comprendre, les organisateurs avaient prévu une autre série de conférences, présentées en parallèle. Cinq conférences ont tenté d'*enseigner* les amplificateurs para-

métriques aux électroniciens non spécialistes. La série était ainsi composée :

P. GRIVET (Faculté des Sciences de Paris) : les phénomènes paramétriques, leur histoire ; principe des amplificateurs paramétriques.

M. Y. BERNARD (Institut National des Sciences et Techniques Nucléaires) : le rôle fondamental d'une impédance non linéaire, traitement analytique général, les relations de Manley et Rowe.

M. BERNARD (Centre National d'Etudes des Télécommunications) : l'évolution vers la mécanique quantite ; analogies et différences entre les amplificateurs paramétriques et les Maser et Laser.

F. BERTEIN (Faculté des Sciences de Paris) : le formalisme matriciel dans le calcul des circuits non linéaires ; quelques exemples de calcul d'amplificateurs paramétriques.

Y. ANGEL (Conservatoire National des Arts et Métiers) : les circuits non linéaires utilisant des ferrites ; amplificateurs paramétriques magnétiques.

Cette armature, constituée par neuf exposés permettait aux participants de profiter pleinement des communications originales, présentées par les physiciens français. Les organisateurs avaient prévu deux après-midi pour ces communications ; l'expérience a montré que ce temps était trop court. Les participants ont pu entendre les exposés de :

G. PIRCHER (Compagnie Française Thomson-Houston) : calcul des amplificateurs paramétriques dans le formalisme des micro-ondes ; calcul de la matrice d'un système non linéaire dans le cas d'une diode.

M. CHAUSSEDOUX (Compagnie Française Thomson-Houston) : détermination des caractéristiques optimum d'un amplificateur paramétrique à diode en U.H.F. ; résultats expérimentaux.

G. MARIE (Laboratoire d'Electronique et de Physique appliquée) : réalisation d'amplificateurs paramétriques à ferrites dans le domaine des basses fréquences (5 à 500.000 Hz).

L. Clément (Centre National d'Etudes des Télécommunications) : amplificateur paramétrique à diode, fonctionnant à 960 MHz, utilisé dans le projet « ECHO I ».

J. P. Roussin (Centre National d'Etudes des Télécommunications) : étude et réalisation des amplificateurs paramétriques à diode, dans la bande des 100 à 1000 MHz.

Ce colloque a permis à des spécialistes appartenant à l'Université (Facultés de Paris, de Dijon, de Grenoble, de Poitiers, Conservatoire National des Arts et Métiers, Centre National de Recherches Scientifiques), à l'Industrie « Nationale » (Office National d'Etudes et de Recherches Aéronautiques, Commissariat à l'Energie Atomique, Centre National d'Etudes des Télécommunications,...) et à l'Industrie privée (C.F.T.H., C.S.F., Laboratoire d'Electronique et de Physique appliquée, L.T.T., Société Alsacienne de Constructions Mécaniques) de confronter leurs points de vue dans les discussions qui ont suivi les exposés. Il a permis aussi aux étudiants du troisième cycle de s'initier à une question d'actualité électronique ; malheureusement la proximité des examens a considérablement freiné l'ardeur de ces derniers pour les nouveautés et l'auditoire ne contenait qu'un nombre limité d'étudiants.

La formule adoptée semble satisfaisante ; le colloque de trois jours est centré sur l'action et la personnalité d'un chercheur de renommée internationale. Les exposés de ce dernier sont flanqués d'un côté d'une armature pédagogique, visant à faire monter les non-spécialistes au niveau des exposés « d'actualité » et d'un autre côté de communications originales, présentant les récents travaux français. Les organisateurs qui souhaitent poursuivre leurs efforts en montant des colloques sur des sujets voisins, expriment leurs remerciements au Directeur de l'I.N.S.T.N., M. Debiesse, qui a bien voulu les accueillir et leur donner les moyens de faire cette réunion.

P. Grivet,

Professeur à la Faculté des Sciences de Paris.

M. Y. Bernard,

Professeur à l'Institut National des Sciences et Techniques Nucléaires, Secrétaire de la Commission VII de l'U.R.S.I.

Vœu émis par les participants du colloque

Les participants aux journées d'études sur les amplificateurs paramétriques émettent le vœu qu'un effort soit fait pour normaliser le vocabulaire technique concernant les amplificateurs paramétriques. Ils souhaitent qu'un glossaire, contenant des définitions précises de chaque terme, soit établi, et, qu'à cette occasion, on adopte *une* locution pour caractériser chaque définition.

Par exemple, le mot « idle » peut se traduire, d'après un dictionnaire classique par = inutile, vain, oisif, paresseux, plaisantin, etc... Or, il est peu probable que ces différents sens permettent de saisir ce qui est le « idle frequency »... ! ! ! Mais le terme « fréquence complémentaire » pourrait être adopté.

Tous les physiciens qui souhaiteraient collaborer à l'établissement de ce glossaire peuvent prendre contact avec les organisateurs des journées d'études (B.P. n° 6 à Gif sur Yvette (S. O.)).

Sweden

Members of the Swedish National Committee of the International Scientific Radio Union 1961-1963

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Vice President : Dr. Hannes ALFVÉN, Professor, Royal Institute of Technology, Valhallavägen 79, Stockholm 70.

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of the Swedish National Committee of U.R.S.I. 1961-1963

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Mr. Carl H. VON SIVERS, Director of Sivers Laboratory, Elektravägen 53, Box 42018, Stockholm 42.

Dr. Lennart STIGMARK, Assoc. Professor, Lund University, Lund.

Mr. Willy STOFFREGEN, Head of Uppsala Ionosphere Laboratory, Division of Research Institute of National Defence, Dep. 3, Uppsala 11.

Mr. Gustaf E. SWEDENBORG, Director of Division, Board of Swedish Telecommunications, Technical Department, Stockholm 16.

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Dr. Torkel WALLMARK, 109, Littlebrook Road, Princeton, N. J., U. S. A.

Mr. Tord WIKLAND, Director, Teleutredningard AB, Framnäsbacken 18, Solna.

U. S. A.

ELECTION OF NEW OFFICERS

The U. S. A. National Committee elected new Officers as follows :

Dr. J. P. HAGEN, *chairman.*

Prof. S. SILVER, *vice-chairman.*

Prof. M. G. MORGAN, *secretary.*

Prof. A. H. WAYNICK, *treasurer.*

Prof. L. MANNING, *associate editor, Information Bulletin.*

SPRING MEETING 1961
(Washington D. C., May 1-4)

The various sessions of this joint meeting with I.R.E. were organizedas follows :

MONDAY, MAY 1.

Combined Technical Sessions

1. The solar wind — E. N. PARKER, Enrico Fermi Institute for Nuclear Studies and Department of Physics, University of Chicago.
2. Sources of X-ray emission in the solar atmosphere — Herbert FRIEDMAN, U. S. Naval Research Laboratory, Washington 25, D. C.
3. Atmospheric phenomena, energetic electrons and the geomagnetic field — John R. WINCKLER, School of Physics, University of Minnesota, Minneapolis, Minn.
4. Theory of the magnetosphere — T. GOLD, Center for Radiophysics and Space Research, Cornell University, Ithaca, N. Y.
5. Some consequences of the interaction between the magnetosphere and the solar wind — W. I. AXFORD, Defence Research Board, Ottawa, Canada.
6. The relation between hydromagnetics and the magneto-ionic theory — C. O. HINES, Defence Research Board, Ottawa, Canada.
7. Geomagnetic storms and hydromagnetic waves — A. J. DESSLER, Lockheed Missiles and Space Division, Palo Alto, Calif.
8. Ducting of electromagnetic waves in the magnetosphere — R. GALLET, Boulder Laboratories, National Bureau of Standards, Boulder, Colo.
9. Ducting of hydromagnetic waves in the magnetosphere — Henry G. BOOKER, Center for Radiophysics and Space Research, Cornell University, Ithaca, N. Y.
10. Generation of radio noise in the vicinity of the earth — P. A. STURROCK, W. W. Hansen Laboratories of Physics, Stanford University, Stanford, Calif.
11. Observations and interpretation of atmospheric radio emission in the decametric range — James W. WARWICK, High Altitude Observatory, University of Colorado, Boulder, Colo.
12. Incoherent scattering by free electrons in the upper atmosphere — J. A. FEJER, Defence Research Board, Ottawa, Canada.

TUESDAY, MAY 2.

COMMISSION I. — *Radio Measurement Methods and Standards*

1. Diurnal phase variations over a 3300-km north-south VLF path — C. R. HAAVE, Johns Hopkins University, Applied Physics Laboratory, Silver Spring, Md.

2. A simplified method for measuring intrinsic resonance properties — George R. JONES, Diamond Ordnance Fuze Laboratories, Washington 25, D. C.
3. Spectral analysis of atmospheric whistlers with coherent memory filter — Jack CAPON and Mark R. WEISS, Federal Scientific Corporation, 615 West 131st Street, New York 27, N. Y.
4. Precision RF power meters using DC for substitution and bias power — Gunther U. SORGER, Weinschel Engineering, Kensington, Md.
5. The determination of noise temperatures of large antennas — D. SCHUSTER and C. T. STELZRIED, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, Calif.
6. In-flight microwave measurement of electron densities at the stagnation point — Thaddeus KALISZEWSKI and Essad TAHAN, Sylvania Electronic Systems, Waltham 54, Mass.
7. A broadband tuning transformer for waveguide systems — Glenn F. ENGEN, National Bureau of Standards, Boulder, Colo.

COMMISSION II. — *Tropospheric Radio Propagation*

1. A non-linear acoustic model for electromagnetic waves — Allen R. EDISON, Electrical Engineering Department, University of New Mexico, Albuquerque, N. Mex.
2. Sea-interferometer measurement of low-angle refraction — L. J. ANDERSON and L. R. HUGHES, Smyth Research Associates, San Diego, Calif.
3. Radio phase distorsion — The first order effect — J. B. SMYTH, Smyth Research Associates, San Diego, Calif.
4. An experiment in radio propagation and communication using a passive reflecting satellite « Echo I » — Clifford M. BEAMER, Collins Radio Company, Cedar Rapids, Iowa.

COMMISSION III. — *Ionospheric Radio Propagation*

1. On the spectra of radio wave scattering from multicomponent plasmas in a magnetic field, and the feasibility of a « radar mass spectrometer » for ionospheric and exospheric studies — T. HAGFORS, O. BUNEMAN, D. WESTOVER and V. ESHLEMAN, Radioscience Laboratory, Stanford University, Stanford, Calif.
2. A theory of incoherent scattering of radio waves by a plasma in a magnetic field — D. T. FARLEY, Chalmers University of Technology, Gothenburg, Sweden ; and J. P. DOUGHERTY and D. W. BARRON, both from University of Cambridge, Cambridge, England.
3. Forward propagation at 440 megacycles by incoherent scattering in the F-region — H. W. BRISCOE and V. C. PINEO, Lincoln Laboratory, Massachusetts Institute of Technology, Cambridge, Mass.

4. On radio communication by means of scattering from density fluctuations in the ionospheric and exospheric plasma — V. R. ESHLEMAN and A. M. PETERSON, Stanford University, Stanford, Calif., and Stanford Research Institute Menlo, Park, Calif.
5. Experimental studies of the F-region using the incoherent backscatter technique at frequencies around 400 megacycles — V. C. PINEO, L. G. KRAFT, H. W. BRISCOE, and D. P. HYNEK, all of Lincoln Laboratory, Massachusetts Institute of Technology, Cambridge, Mass.
6. Coherent non-linearities in a magneto-ionic medium — Lester F. EASTMAN, Chalmers University of Technology, Gothenburg, Sweden.

Electron Density and Rocket Measurements.

1. Recent work on upper atmosphere electron densities at the Cavendish Laboratory, Cambridge — A. R. ROBBINS, Cavendish Laboratory, Cambridge, England.
2. A new method for the calculation of N(h) profiles from ionospheric $h'(f)$ curves, and the joint use of the ordinary and extraordinary curves in determining the profile below $f$min — Hisashi HOJO, Ionosphere Research Laboratory, Pennsylvania State University, University Park, Pa.
3. Experimental measurements of electron temperature and electron and ion density by a direct measurement and a propagation technique — N. W. SPENCER, Goddard Space Flight Center, National Aeronautics and Space Administration, Washington, D. C.; L. H. BRACE, University of Michigan, Ann Arbor, Mich.; C. R. CARIGNAN, University of Michigan, Ann Arbor, Mich.; and W. W. BERNING, Ballistic Research Laboratory.
4. An ion-trap measurement of the ion concentration profile above the F2 peak — D. D. MCKIBBIN, and W. B. HANSON, Lockheed Missiles and Space Division, Palo Alto, Calif.
5. Rocket measurements of auroral radio absorption at Fort Churchill, Canada, during October 1960 — W. J. HEIKKILA and S. R. PENSTONE, Defence Research Telecommunications Establishment, Ottawa, Ontario.
6. Ionosphere measurements at Fort Churchill — John C. MESTER and Raymond E. PRENATT, Ballistic Research Laboratories, Aberdeen Proving Ground, Aberdeen Md.

COMMISSION IV. — *Radio Noise of Terrestrial Origin*

Sferics and Whistlers.

1. Whistler data on the change of base level ionization in the whistler medium following magnetic storms — D. L. CARPENTER, Radioscience Laboratory, Stanford University, Stanford, Calif.
2. Radiation field characteristics of lightning discharges in the band 1 kc/s to 100 kc/s — W. L. TAYLOR, National Bureau of Standards, Boulder, Colo.

3. Synoptic observations of whistler-mode signals from VLF transmitters — R. A. HELLIWELL, J. KATSUFRAKIS, and G. CARPENTER, all of Radioscience Laboratory, Stanford University, Stanford, Calif.
4. The Pacific Naval Laboratory — Stanford University conjugate point experiment — J. E. LOKKEN, J. A. SHAND, and C. S. WRIGHT, Pacific Naval Laboratory, Defence Research Board, Canada ; together with L. H. MARTIN, N. M. BRICE, and R. A. HELLIWELL, Radioscience Laboratory, Stanford University, Stanford, Calif.
5. The average rate of lightning flashes to ground — Robert C. DAVIS, National Bureau of Standards, Boulder, Colo.
6. Synoptic weather and sferic phenomena — A. SAMSON and R. F. LINFIELD, Boulder Laboratories, National Bureau of Standards, Boulder, Colo.
7. Determining the direction of arrival of whistlers and ionosferics — L. C. SEMPREBON and M. G. MORGAN, Thayer School of Engineering, Dartmouth College, Hanover, New Hampshire.

VLF/ELF.

1. Measurement of effective ground conductivity at low radio frequencies by a recording and subsequent analysis of the sferic signatures from thunderstorms — J. R. JOHLER, C. M. LILLEY, and E. A. BERGER, Boulder Laboratories, National Bureau of Standards, Boulder, Colo.
2. Studies of VLF phenomena in the antarctic — L. H. MARTIN, Radioscience Laboratory, Stanford University, Stanford, Calif.
3. The spectrum of terrestrial radio noise at extremely low frequency — H. R. RAEMER, Applied Research Laboratory, Sylvania Electric Products Inc., Waltham 54, Mass.
4. The phase variations of 16 kc/s transmissions from Rugby, England, as received in Boulder, Colorado — Charles J. CHILTON, National Bureau of Standards, Boulder, Colo.
5. Attenuation coefficients at very low frequencies (VLF) during a sudden ionospheric disturbance (S.I.D.) — E. T. PIERCE, Stanford Research Institute, Menlo Park, Calif.
6. Calculation and interpretation of VLF field strengths, polarizations and angles of arrival — J. H. CRARY and R. A. HELLIWELL, Radioscience Laboratories, Stanford University, Stanford, Calif.
7. Satellite observations of whistlers above the ionosphere — J. C. CAIN, National Aeronautics and Space Administration, Washington 25, D. C.
8. Penetration of the ionosphere by very low frequency radio signals : some initial results of the LOFTI 1 experiment — L. S. BEARCE and C. E. YOUNG, U. S. Naval Research Laboratory, Washington 25, D. C.
9. Some LOFTI 1 delay and Doppler measurements — L. H. RORDEN, Stanford Research Institute, Menlo Park, Calif., and R. A. HELLIWELL, Stanford University, Stanford, Calif.

COMMISSION V. — *Radio Astronomy*

General Radio Astronomy.

1. Radio Telescopes of the Soviet Union — G. SWENSON and R. BRACEWELL — University of Illinois and Stanford University respectively
2. The Benelux cross antenna project — C. L. SEEGER, Leiden Observatory, Holland.
3. Survey report of 21-cm Maser observations at Harvard — Morton S. ROBERTS, Harvard' College Observatory, Cambridge, Mass.
4. Spectral indexes of 48 discrete sources — Samuel J. GOLDSTEIN, Jr. The George R. Agassiz Station, Harvard College Observatory, Harvard, Mass.
5. Antenna temperature and attenuation due to atmospheric oxygen at millimeter wavelengths — M. L. MEEKS, Georgia Institute of Technology, Atlanta, Ga.
6. Ionosphere of the Moon — S. F. SINGER, and E. H. WALKER, University of Maryland, College Park, Md.
7. Observations of polarized cosmic background radiations at 408 Mc — C. L. SEEGER and G. WESTERHOUT, Leiden Observatory, Holland.

COMMISSION VI. — *Radio Waves and Circuits*

Anisotropic Media and Plasmas.

1. A new way of solving Maxwell's equations — V. H. RUMSEY, University of California at Berkeley, Calif.
2. Propagation through a twisted medium — G. C. MCCORMICK, Radio and Electrical Engineering Division, National Research Council, Ottawa, Canada.
3. The near field supported by a source —excited plasma slab — T. TAMIR and A. A. OLINER, Polytechnic Institute of Brooklyn, 55 Johnson Street, Brooklyn 1, N. Y.
4. A full-wave solution for very low-frequency electromagnetic waves in a magnetoplasma — W. C. HOFFMAN, Boeing Scientific Research Laboratories, Seattle 24, Wash.
5. Radiation from a modulated electron beam with a plasma background — Philip PARZEN, Republic Aviation Corp., Farmingdale, N. Y.
6. Study in plasma induced voltage break-down — W. E. SCHARFMAN and T. MORITA, Stanford Research Institute, Menlo Park, Calif.

WEDNESDAY, MAY 3.

COMMISSION II. — *Tropospheric Radio Propagation*

Diffraction and Mode Theory.

1. On the diffraction of radio waves from an electrical point source in the vicinity of a finitely conducting sphere — L. C. WALTERS and J. R. JOHLER, Boulder Laboratories, National Bureau of Standards, Boulder, Colo.

2. Scattering of a transverse electric ground wave by a ridge — G. Alan CLARK, Aerospace Division, Boeing Airplane Company, Seattle, Wash.
3. Some new representations for the height-gain functions for the case of normal refraction — N. A. LOGAN and R. L. MASON, Missiles and Space Division, Lockheed Aircraft Corporation, Sunnyvale, Calif.
4. On the presentation of ground-wave propagation curves — N. A. LOGAN, Missiles and Space Division, Lockheed Aircraft Corporation, Sunnyvale, Calif.
5. A new asymptotic expansion for Legendre functions encountered in the propagation over spherical surfaces — N. A. LOGAN and K. S. YEE, Missiles and Space Division, Lockheed Aircraft Corporation, Sunnyvale, Calif.
6. Mode theory as proof of partial internal reflections from the normal air — Thomas J. CARROLL, Bendix Radio, Towson, Md.

Long-Range Tropospheric Propagation.

1. Statistical Analysis of transmission data from a simultaneous frequency-and-angle experiment — D. GJESSING, C. S. LISTON, and A. T. WATERMAN, Jr., Stanford Electronics Laboratories, Stanford University ; Stanford, Calif.
2. Internal waves on a refractive layer and their effect on tropospheric propagation — Earl E. GOSSARD, U. S. Naval Electronics Laboratory, San Diego 52, Calif.
3. VGF air-ground twilight propagation enhances by index gradients and tropospheric stability — W. C. VERGARA, J. L. LEVATICH, and T. J. CARROLL, The Bendix Corporation, Towson 4, Md.
4. Stochastic effects of the troposphere on the field of an oscillating dipole — Eugene C. BARROWS, National Bureau of Standards, Boulder, Colo.
5. Atmospheric turbulence and star scintillation — S. H. REIGER, The Rand Corporation, 1700 Main Street, Santa Monica, Calif.
6. A selective survey of foreign scatter development — John H. BARTON, U. S. Navy, Department of Defence, Washington 25, D. C.
7. A study of the north Atlantic trade wind duct — J. C. KATZIN, A. B. WASHBURN, Jr., E. A. BONDURANT, all of Electromagnetic Research Corporation, Washington D. C.

COMMISSION III. — *Ionospheric Radio Propagation*

Propagation Theory.

1. The interpretation and synthesis of certain spread F configurations appearing on equatorial ionograms — Wynne CALVERT and Robert COHEN, Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colo.

2. On the nature of equatorial slant sporadic E — Robert COHEN, Kenneth L. BOWLES, and Wynne CALVERT, Central Radio Propagation Laboratory, National Bureau of Standards, Boulder, Colo.
3. Wave guide propagation down elongated irregularities in the ionosphere — H. G. BOOKER and M. L. V. PITTEWAY, Cornell University, Ithaca, N. Y.
4. On ionospheric HF radio ducts across Equator — Ming S. WONG, Air Force Cambridge Research Laboratories, Electronic Research Directorate, CRRKP, Bedford, Mass.
5. Non-linear magneto-ionic theory — O. E. H. RYDBECK, Research Laboratory of Electronics, Chalmers University of Technology, Gothenburg, Sweden.

Dynamics, Storms and the Protonosphere.

1. On a formation of the Es and its lunar tidal variations — S. MATSUSHITA, High Altitude Observatory, University of Colorado, Boulder, Colo.
2. The coupling between the protonosphere and the normal F-region — W. B. HANSON and I. B. ORTENBURGER, Missiles and Space Division, Lockheed Aircraft Corp., Palo Alto, Calif.
3. Atmospheric density measurements with a satellite-borne microphone gage — G. W. SHARP, W. B. HANSON, and D. D. MCKIBBIN, Missiles and Space Division, Lockheed Aircraft Corporation, Palo Alto, Calif.
4. Experimental evidence of localized magnetic field distortions in the E layer — R. S. LEONARD, Geophysical Institute, University of Alaska, College, Alaska.
5. Some relations between ionospheric, magnetic and auroral activity and their dependence on position — W. R. PIGGOTT, Slough, England.
6. Relation between ionospheric and geomagnetic storms — Gerald F. ROURKE, Research and Advanced Development Division, AVCO Corporation, Wilmington, Mass.

COMMISSION V. — *Radio Astronomy*

Solar Radio Astronomy.

1. Status report on the allocation of frequencies for radio astronomy and related research programs — Richard M. EMBERSON, National Radio Astronomy Observatory, Associated Universities, Inc., New York 19, N. Y.
2. Plasma clouds associated with space vehicles — S. F. SINGER, Department of Physics, University of Maryland, College Park, Md.
3. The polar diagram of an antenna situated above F2 maximum and operating below f_0F2 — Dennis WALSH, The Observatory, University of Michigan, Ann Arbor, Mich.

4. The radar cross section of the sun — D. W. SWAYZE, Philco Corporation, Western Development Laboratories, Palo Alto, Calif.
5. The sun as a radio test source — R. N. BRACEWELL, Stanford University, Palo Alto, Calif.
6. Audio spectrum studies of the modulation of solar radio noise — J. AARONS, S. BASU, W. KIDD, and R. S. ALLEN, Air Force Cambridge Research Laboratories (A.R.D.C.), Laurence G. Hanscom Field, Bedford, Mass.
7. Radiation at 4,3 mm wavelength during the 15 February 1961 solar eclipse — C. W. TOLBERT, L. C. KRAUSE, and A. W. STRAITON, University of Texas, Austin, Tex.
8. Estimates of electron densities above solar active regions based on recent radio observations — G. SWARUP, Radioscience Laboratory, Stanford University, Stanford, Calif.

COMMISSION VI. — *On Radio Waves and Circuits*

Scattering Theory.

1. Plane wave spectra in multiple scattering theory — R. F. MILLAR, Institute of Mathematical Sciences, New York University, New York, N. Y.
2. Semi-infinite diffraction gratings — Norman L. HILLS and S. N. KARP, Institute of Mathematical Sciences, New York University, New York, N. Y.
3. Aperture fields of an array of rectangular apertures — Richard B. KIEBURTZ and Akira ISHIMARU, University of Washington, Seattle, N. Y.
4. Diffraction of a cylindrical wave by a strip — E. B. HANSEN, Institute of Mathematical Sciences, New York University, New York City.
5. Wave functions associated with a bilinear spherically stratified medium — CHEN TO TAI, Antenna Laboratory, Department of Electrical Engineering, Ohio State University, Columbus 10, Ohio.
6. Scattering of an electro-magnetic wave by a sphere — Ira L. KARP, Aero-Space Division, Boeing Airplane Company, Seattle, Wash.

High Frequency Scattering Problems.

1. A new geometrical theory of diffraction — N. A. LOGAN and K. S. YEE, Missiles and Space Division, Lockheed Aircraft Corporation, Sunnyvale, Calif.
2. Diffraction of pulses by convex surfaces — N. A. LOGAN and K. S. YEE, Missiles and Space Division, Lockheed Aircraft Corporation, Sunnyvale, Calif.

3. Current induced on circular cylinders by slots — Gerard HASSERJIAN, Antennas and Radomes Unit, Development Center, Boeing Airplane Company, Seattle, Wash.; and Akira USHIMARU, Department of Electrical Engineering, University of Washington, Seattle, Wash.
4. The back scattering from a circular disk — Robert V. DE VORE and Robert G. KOUYOUMJIAN, Department of Electrical Engineering, Ohio State University, Columbus 10, Ohio.
5. The field near to, and beyond, the focus of a micro-wave collimating system — F. H. NORTHOVERN Department of Mathematics, Carleton University, Ottawa, Canada.
6. Radar Measurements on scattering operators — J. Richard HUYNEN, Missiles and Space Division, Lockheed Aircraft Corporation, Sunnyvale, Calif.

TUESDAY, MAY 4.

COMMISSION III. — *Ionospheric Radio Propagation*

Sporadic E and Scattered Signals.

1. Theory of overhead nonblanketing sporadic E — Jacques RENAU, Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y.
2. Worldwide sporadic E occurrence as observed at vertical incidence during the I.G.Y. — Hope I. LEIGHTON, Ionosphere Research and Propagation Division, Boulder Laboratories, National Bureau of Standards, Boulder, Colo.
3. A report on sporadic E studies at Boulder — J. F. GREGORIO, J. W. FINNEY, K. KILDAHL and E. K. SMITH, Boulder Laboratories, National Bureau of Standards, Boulder, Colo.
4. Anomalous HF propagation by way of Field-aligned and other irregularities in the F-region — Clay D. WESTLUND and E. C. HAYDEN, Electrical Engineering Research Laboratory, University of Illinois, Urbana, Ill.
5. Ionospheric irregularities and long-distance radio propagation — H. A. WHALE, Seagrove Radio Research Station, Auckland, New Zealand.
6. Observed directions of arrival of ionospherically scattered signals — A. C. WILSON and H. V. COTTONY, Boulder Laboratories, National Bureau of Standards, Boulder, Colo.

The lower ionosphere.

1. A case study of possible tropospheric-ionospheric coupling — Conrad P. MOOK, Diamond Fuze Ordnance Laboratories, Washington D. C.
2. Vertical energy flux into the lower ionosphere by internal gravity waves generated in the troposphere — Earl E. GOSSARD, U. S. Navy Electronics Laboratory, San Diego 52, Calif.

3. Partial reflection of pulsed radio waves from the ionospheric D — and E-regions — J. S. Belrose, Defence Research Telecommunications Establishment, Defence Research Board, Ottawa, Canada ; and M. J. Burke, on leave from Physics Department, Queensland University, Brisbane, Australia.
4. Experiment Luxembourg : cross modulation at high latitude, low height — Gian Carlo Rumi, Geophysical Institute, University of Alaska.
5. The lower edge of the night-time E-layer from rocket measurements — E. A. Mechtly and S. A. Bowhill, Ionosphere Research Laboratory, Pennsylvania State University, University Park, Pa.
6. The nocturnal E-layer — William S. Hough, National Bureau of Standards, Boulder, Colo.

Commission VI. — Radio Waves and Circuits

Information and Circuit Theory.

1. Information theory applied to antenna design — G. O. Young, University of Southern California, and A. Ksienski, Aerospace Engineering Division, Hughes Aircraft Company, Culver City, Calif.
2. A generalization of woodward's theorem and the spectrum of a high harmonic of a sinusoid plus narrow-band gaussian noise — Nelson M. Blachman, Sylvania Electronic Defence Laboratories, Mountain View, Calif.
3. Optimum nonlinear filters for quantized inputs — F. Tung and R. J. Schwarz, Department of Electrical Engineering, Columbia University, New York 27, N. Y.
4. The minimum period of oscillation of simple tunnel diode oscillators — D. K. Lynn, R. S. Pepper, and D. O. Pederson, Electronics Research Laboratory, University of California, Berkeley, Calif.
5. Microminiaturization of space guidance computer circuitry — Edward Keonjian, American Bosch Arma Company, Garden City, N. Y.
6. On the realization of resistive N-port networks — I. Cederbaum, Department of Electrical Engineering, Columbia University, New York 27, N. Y.

Antennas.

1. Radiation from periodic structures with application to frequency independent antennas — Paul E. Mayes, W. T. Patton, and Georges A. Deschamps, Antenna Laboratory, University of Illinois, Urbana, Ill.
2. A versatile reflector design for passive satellite use — Virginia Norwood, Aerospace Engineering Division, Hughes Aircraft Company, Culver City, Calif.
3. Arrays with spacing taper — Andrew L. Maffett, Institute of Science and Technology, University of Michigan, Ann Arbor, Mich.

4. Reiterative wave beams of rectangular symmetry — F. SCHWERING, U. S. Army Signal Research and Development Laboratory, Fort Monmouth, N. J.
5. Circular arc antenna arrays backed by corner angle reflectors — Arthur C. HORSNELL and J. D. TILLMAN, Jr., Engineering Experiment Station, University of Tennessee, Knoxville, Tenn.
6. A quasi-isotropic antenna in the microwave spectrum — Dimitri S. BUGNOLO, Bell Telephone Laboratories, Holmdel, N. J.
7. A mathematical analysis of a surface wave antenna of finite length — Julius KANE, Department of Electrical Engineering, University of Rhode Island, Kingston, R. I.
8. Waves guided by moving periodic plane boundaries — E. S. CASSEDY, Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, N. Y.
9. Propagation constants for surface waves on convex surfaces — N. A. LOGAN, Missiles and Space Division, Lockheed Aircraft Corporation, Sunnyvale, Calif.
10. Calculated and measured polarization distributions in the central plane of a Luneburg lens antenna — L. DUBROWSKY, D. A. QUESINBERRY, and H. E. SCHRANK, Westinghouse Electric Corp., Friendship International Airport, Box 1897, Baltimore Md.
11. An experiment study of the dipole antenna immersed in a conducting medium — Keigo IIZUKA, Gordon MACKAY Laboratory, Harvard University; and Ronald W. P. KING, Gordon McKay Professor of Applied Physics, Harvard University, Cambridge, Mass.
12. The electrically short antenna as a probe for measuring free electron densities and collision frequencies in an ionized region — Ronald W. P. King, Charles W. HARRISON, Jr., and David H. DENTON, Jr. Sandia Laboratory, Sandia Base, Albuquerque, N. Mex.

Lower-Power Systems for Space Probing and Communications.

1. Narrow-band signal detection — R. G. STEPHENSON, Aerospace Corporation, Los Angeles, Calif.
2. A long-range precision ranging system — M. EASTERLING, Jet Propulsion Laboratory, Pasadena, Calif.
3. Threshold effects of the FM demodulator with feedback — L. H. ENLOE and C. L. RUTHROFF, Bell Telephone Laboratories, Inc., Holmdel, N. J.
4. Fundamental sensitivity limitations for second-order phase locks loops — Jean A. DEVELET, Jr., Space Technology Laboratories, Los Angeles, Calif.
5. A comparison of feedback FM and PCM for space communications — E. BEDROSIAN, Rand Corporation, Santa Monica, Calif.
6. On the theoretical limitations of wide-band communications systems — J. C. HANCOCK, E. M. SHEPPARD, and W. D. WADE, Purdue University, Lafayette Ind.

1962 INTERNATIONAL CONFERENCE ON PRECISION ELECTROMAGNETIC MEASUREMENTS

The 1962 International Conference on Precision Electromagnetic Measurements, formerly the Conference on Standards and Electronic Measurements, will be held August 14, 15, and 16, 1962, at the Boulder Laboratories of the National Bureau of Standards, Boulder, Colorado.

This Conference is sponsored by the Radio Standards Laboratory of the National Bureau of Standards, the Professional Group on Instrumentation of the Institute of Radio Engineers, and the Instrumentation Division of the American Institute of Electrical Engineers. Previous conferences (1958 and 1960) each attracted more than 800 participants from industrial, university, and government laboratories throughout the world.

The call for papers will be mailed about October 30, 1961. This will outline the general theme and technical program. Briefly, however, the program will be similar to the 1958 and 1960 conferences in that the basic emphasis will be upon the fundamental aspects of precise and accurate electromagnetic measurement throughout the entire frequency spectrum ; it will differ from past conferences in that it will consider the impact of new fields of science, such as quantum electronics, upon precision measurement, and in that it will not include papers on the organization and operation of standards laboratories. (The last subject, however, might be considererd in a separate conference which would immediately follow this one.)

The Conference will be of particular interest to members of Commissions I, VI, and VII of U.R.S.I.

U. S. S. R.

A. S. POPOV'S GOLD MEDAL CONTEST

The Division of Technical Sciences of the U. S. S. R. Academy of Sciences announces the Contest for A. S. Popov's Gold Medal in 1962.

A. S. Popov's Gold Medal is awarded for distinguished scientific works and inventions in the field of radioengineering performed during the period from 1959 to 1961.

The medal is awarded both to the Soviet and foreign scientists.

The papers can be submitted by research and educational institutes, design offices, scientific societies, government departments, by academicians and corresponding members of the U. S. S. R. Academy of Sciences.

For the A. S. Popov's Gold Medal Contest are to be submitted :

Scientific publications (series of papers), discoveries or inventions in triplicate ; a testimonial of the scientific value and the importance of this work for the progress of science and engineering, it should be appended by a brief biographical note of the author with a list of main scientific papers and inventions.

The papers with the inscription « For the A. S. Popov's medal contest » should be adressed to the Scientific Council on Radiophysics and Radioengineering of the Academy of Sciences of the U. S. S. R., Moscow K-9, Mokhovaya II.

The deadline for submitting papers — February 1, 1962.

COMMISSIONS AND COMMITTEES

Sweden

LIST OF OFFICIAL MEMBERS

Section of the Swedish National Committee	Chairman and Official Member of the Corresponding U.R.S.I. Commission	
N°	Name and Address	Remark
I	Mr. Per-Olof LUNDBOM, Head of Division, Research Institute of National, Defence, Dep. 3, Stockholm 80	New elected
II	Dr. Bengt JOSEPHSON, Head of Division, Research Institute of National Defence, Dep. 3, Stockholm 80	Reelected
III	Mr. Sven GEJER, Director of Division, Board of Swedish Telecommunications, Radio Department, Stockholm 16	Reelected
IV	Dr. Dietrich MULLER-HILLEBRAND, Professor, Institute of High-Tension Research, Uppsala	Reelected
V	Dr. Olof E. H. RYDBECK, Professor, Chalmers Institute of Technology, Gibraltargatan 5 G, Gothenburg	Reelected
VI	Dr. Bertil AGDUR, Professor, Royal Institute of Technology, Valhallavägen 79, Stockholm 70	New elected
VII	Dr. Henry WALLMAN, Professor, Chalmers Institute of Technology, Gibraltargatan 5 P, Gothenburg	Reelected

United Kingdom

LIST OF OFFICIAL MEMBERS

Commission I : Dr. L. Essen, National Physical, Laboratory, Teddington, Middlesex.

Commission II : Dr. J. A. Saxton, D.S.I.R. Radio Research Station, Ditton Park, Slough, Bucks.

Commission III : Prof. W. J. G. Beynon, C.B.E., Department of Physics, University College of Wales, Aberystwyth.

Commission IV : Mr. F. Horner, D.S.I.R. Radio Research Station, Ditton Park, Slough, Bucks.

Commission V : Dr. F. G. Smith, Cavendish Laboratory, Free School Lane, Cambridge.

Commission VI : Prof. H. M. Barlow, F.R.S., 12 Higher Drive, Banstead, Surrey.

Commission VII : Prof. C. W. Oatley, O.B.E., Engineering Laboratory, Trumpington Street, Cambridge.

Commission III. — On Ionospheric Radio

METEORIC RADIO WAVE PROPAGATION

We call the attention of our readers to NBS-Boulder Laboratories Technical Note n° 94 : *Bibliography on Meteoric Radio Wave Propagation*, by W. Nupen.

This bibliography constitutes the second in a series of four or five being prepared by Meteorological Abstracts for the Boulder Laboratories of the National Bureau of Standards. The general subject area of these compilations is *Propagation of Electromagnetic (Radio) Waves in the Atmosphere.*

The first, comprising over 1,400 titles, was concerned with normal or abnormal *Ionospheric propagation.*

The present bibliography consists of 368 abstracts on *Meteor Trail Propagation*, arranged alphabetically by author and including articles dating from the earliest studies by Nagaoka in 1929 on the

effect of meteoric ionization on radiocommunication, to the numerous papers reflecting the recent emphasis on meteor burst communication. No material published after 1960 has been included.

Future bibliographies will cover the subjects of *Radio Reflections from Auroras*, *Radioastronomy* and *Tropospheric Radio Wave Propagation*.

Abstracts have been taken, in the main, from the published or unpublished abstracts in the files of *Meteorological Abstracts and Bibliography* (1950-1959) or *Meteorological and Geoastrophysical Abstracts* (1960).

Commission IV
On Radio Noise of Terrestrial Origin

BIBLIOGRAPHY

We call the attention of our readers to Volume V of the « I.G.C. Data on Atmospherics, Whistlers and Solar Radio Emissions » (from July 1 to December 31, 1959) which has been issued by the Japanese National Committee for the International Co-operation in Geophysics, and to the following work, published under the auspices of the Institut Suisse de Météorologie : « Mesures des parasites atmosphériques, d'électricité atmosphérique et de radioactivité de l'air à Murchison Bay (Spitzberg), Payerne et Zurich », by J. Lugeon, A. Junod, P. Wasserfallen and J. Rieker.

Commission V. — On Radio Astronomy

BIBLIOGRAPHY

We call the attention of the members of the Commission to Volume V of the « I.G.C. Data on Atmospherics, Whistlers and Solar Radio Emissions » (from July 1 to December 31, 1959) which has been issued by the Japanese National Committee for the International Co-operation in Geophysics.

U.R.S.I.-C.I.G. Committee

LETTER FROM THE CHAIRMAN

Dear Colleague,

You will recall that at our last meeting in September 1960 in London, it was agreed that consideration be given to holding a Symposium on I.G.Y. Vertical Sounding Results. It has now been decided to hold this Symposium at Nice, on 11-16 December 1961. It has also been considered desirable to devote some part of this meeting to a consideration of I.G.Y. absorption and drift measurements.

The vertical soundings section of this meeting is being organized by the World Wide Soundings Sub-Committee and the drifts and absorption discussions by the respective co-ordinators Dr. K. Rawer and Mr. W. R. Piggott.

August 29, 1961.

W. J. G. Beynon, *Chairman.*

G. M. Brown, *Secretary.*

ANNÉE INTERNATIONALE DU SOLEIL CALME (INTERNATIONAL YEAR OF THE QUIET SUN) I.Q.S.Y.

Une proposition officielle pour un programme de recherches géophysiques à l'époque du prochain minimum d'activité solaire a été présentée à la réunion du Comité International de Géophysique (C.I.G.) en août 1960.

L'intérêt d'un nouvel effort dans certaines disciplines géophysiques au cours d'une période de minimum d'activité solaire est évident. Dans les disciplines telles que le géomagnétisme, les aurores et le ciel nocturne, l'ionosphère, l'aéronomie, l'activité solaire et les rayons cosmiques, les résultats obtenus pendant la période de maximum d'activité solaire de l'A.G.I. auront une valeur beaucoup plus grande s'ils sont complétés par un programme réduit d'observations au cours de la prochaine période de minimum d'activité. Il est entendu que le programme de minimum d'activité solaire ne doit pas être considéré comme une répétition à une échelle réduite de l'A.G.I., mais que l'on se servira des nouvelles connais-

sances, acquises pendant l'A.G.I., des relations entre les phénomènes solaires et terrestres ainsi que des nouvelles techniques mises au point récemment pour les recherches géophysiques.

Le Comité International de Géophysique a discuté cette proposition en détail à sa réunion à Paris en 1961. Il a décidé que le projet serait appelé l'Année Internationale du Soleil Calme et désigné par le sigle I.Q.S.Y. (International Year of the Quiet Sun) ; qu'il se déroulerait du 1er avril 1964 au 31 décembre 1965 et qu'il comprendrait les disciplines suivantes : jours mondiaux, météorologie, géomagnétisme, aurores et ciel nocturne, ionosphère, activité solaire, rayons cosmiques et aéronomie.

Un Groupe de Travail comprenant les représentants du C.I.G. pour les disciplines énumérées ci-dessus, a préparé des recommandations pour le programme à entreprendre pendant l'I.Q.S.Y. Ces recommandations figurent dans la cinquième partie « Preliminary Programmes for I.Q.S.Y.-65 », pages 13 à 20 de la *Chronique de l'U.G.G.I.*, n° 34, ou pages 119 à 126 du *C.I.G. Bulletin*, n° 4, mars 1961 (*U.R.S.I. Information Bulletin*, n° 124).

Le Comité International de Géophysique a soumis un rapport de cette réunion ainsi que les propositions relatives à l'Année Internationale du Soleil Calme aux Comités nationaux en leur demandant leur avis et leur coopération. Les Comités étaient invités à formuler des programmes provisoires avant le 1er décembre 1961.

La quatrième réunion du C.I.G. aura lieu au début de l'année 1962. Il a été proposé d'inviter des représentants de tous les pays qui ont l'intention de participer à l'I.Q.S.Y. à assister à cette réunion, et de réunir un Comité Consultatif, composé des chefs de délégation des pays représentés, pour discuter des problèmes de coopération et de l'établissement et/ou de la continuation des Centres Mondiaux de Données, du développement des expéditions mixtes, etc.

Tous les pays qui désirent s'associer au programme de l'I.Q.S.Y. sont instamment priés d'envoyer une délégation ou des observateurs à cette réunion et d'indiquer dans quelle mesure ils se proposent de participer à l'I.Q.S.Y.

Date et lieu de la réunion.

Etant donné qu'une telle réunion demande une longue préparation et que, d'autre part de nombreux professeurs sont très pris

par leurs charges universitaires en début d'année il est proposé de tenir cette réunion aux environs du 20 mars 1962.

Les propositions que vous pourrez me soumettre pour le lieu de la réunion seront les bienvenues. Il est possible de l'organiser à Paris et si aucune autre proposition n'est formulée elle se tiendra à Paris.

1er septembre 1961.

G. LACLAVERE,
Secrétaire Général
du Comité International de Géophysique.

SUNSPOT ZERO PREDICTIONS

We are now approaching the period of low sunspot numbers. Sunspot number is used as an indication of the level of solar activity. When the sunspot numbers are low the solar activity is low, the ionospheric layers are less dense and the MUF's for short wave radio communication circuits are low.

It is anticipated that the sunspot minimum will occur in 1964 or 1965 when it will be close to zero but not necessarily actually zero. This, of course, will be the time when the MUF's are lowest.

In order that users of the predictions may be able to anticipate the worst conditions likely to be experienced we are producing a complete set of the prediction charts for sunspot zero. These will take exactly the same form as the regular predictions such as Series A, P or U but will be in bright orange covers and appropriately labelled.

They will be produced at the same time as the regular predictions for 1962. However, they will be sent out separately from the corresponding regular predictions. Thus the complete set should be available towards the end of 1962. The quantities and addresses used for despatching these special predictions will be the same as for the regular predictions. If extra copies of these special predictions are required they can be supplied on request.

We suggest that users who feel that they do not require the special predictions continue to receive them and put them aside.

It has been our experience that users will find this sort of material very helpful as the available frequency spectrum for HF communication becomes narrower.

8 September 1961.

Ionospheric Prediction Service
5, Hickson Road,
Millers Point, N.S.W.
Australia.

BIBLIOGRAPHY

Volume V of the « I.G.C. Data on Atmospherics, Whistlers and Solar Radio Emissions » (from July 1 to December 31, 1959) has been issued by the Japanese National Committee for the International Co-operation in Geophysics.

On the other hand, we call the attention of our readers to the following work published under the auspices of the Institut Suisse de Météorologie : « Mesures des parasites atmosphériques, d'électricité atmosphérique et de radioactivité de l'air à Murchison Bay (Spitzberg), Payerne et Zurich », by J. Lugeon, A. Junod, P. Wasserfallen and J. Rieker.

SYMPOSIA

Symposium on Electromagnetic Theory and Antennas

FINAL ANNOUNCEMENT — REGISTRATION

A « Symposium on Electromagnetic Theory and Antennas » will be held at the Technical University of Denmark, Copenhagen, from Monday, June 25th, to Saturday, June 30th, 1962, both days inclusive. The symposium will be open to any interested person from any country.

The symposium is sponsored by The International Scientific Radio Union (U.R.S.I.), The Technical University of Denmark, The Danish Academy of Technical Sciences, and The Danish National Committee of U.R.S.I. Financial aid for arranging the symposium has been given by the International Radio Union and by Danish firms, institutions and foundations.

On the basis of papers which have been received to date a number of topics has been selected, and each of these has been assigned coordinators. The topics and the coordinators are : Propagation of guided and unguided electromagnetic waves in anisotropic media (N. Marcuvitz and J. R. Wait), Scattering in random media (S. Silver and A. D. Wheelon), Propagation along and radiation from modulated structures (A. Oliner), Properties of partially coherent electromagnetic fields (F. J. Zucker), Recent developments in diffraction theory (K. M. Siegel and J. B. Keller), and Antennas (R. C. Hansen and H. L. Knudsen).

Additions to the list will be made if the situation should require so.

Authors of papers already accepted include — B. Agdur, P. Beckmann, A. Blanc-Lapierre, K. Bochenek, H. G. Booker, H. Bremmer, K. G. Budden, P. C. Clemmow, A. L. Cullen, R. H. DuHamel, G. Eckart, L. Felsen, W. Franz, K. Furutsu, Z. Godzinski, R. W. Gould, R. C. Hansen, A. E. Heins, W. C. Hoffman, A. E. Karbowiak, S. Karp, I. Kay, J. B. Keller, M. Kline, N. Logan, L. Mandel, N. Marcuvitz, M. Motz, A. A. Oliner, G. B. Parrent, P. Poincelot, Mogens Pihl, V. Rumsey, O. H. Ryd-

beck, H. Seidel, T. B. A. Senior, K. M. Siegel, S. Silver, G. Toraldi di Francia, V. Twersky, V. H. Weston, A. D. Wheelon, J. Voge, J. R. Wait, E. Wolf, and J. Zucker.

Additional papers may be accepted for presentation. These should be sent to the Technical Program Committee at the above address and should be in the form of a three-page summary containing not less than 800 and not more than 1200 words. They should be carefully written as they will form the basis of selection. The deadline for receipt of these summaries is December 1st, 1961. However, it is desirable that as many papers as possible reach Copenhagen at a considerably earlier date. The summaries of the accepted papers will also be used as manuscripts for mimeographed preprints. A maximum of one page (210 × 297 millimeters, 25 millimeters of margin on all sides) of illustrations can, if necessary, be included in each preprinted summary. The figures should preferably be drawn in Indian ink in scale 1 : 1. It is mandatory that all papers are presented (in English or French) by the author or by one of the authors in the case of multiple authorship. The final manuscript will not be needed until the symposium itself. An Editorial Board will select those papers which are to be published in full in the proceedings. It is expected that the remainder will be published in the form of abstracts.

A registration form and a hotel reservation form can be obtained by writing to the secretary for the symposium, Professor H. Lottrup Knudsen, The Technical University of Denmark, Øster Voldgade 10 G, Copenhagen, Denmark.

These forms will be accepted until the last day of the symposium ; however, due to the severe hotel situation in Copenhagen, the Symposium Committee can undertake to make hotel reservations only for those who have registered and paid the registration fee before March 1st, 1962. Reservations will be made as close as possible to indicated wishes. The delegates who have registered before this date will also receive, by mail, summaries of the accepted papers. The registration fee is 100 D.cr. A check for this amount should be enclosed with the completed registration form. The check should be made payable to the « Symposium on Electromagnetic Theory and Antennas », The Technical University of Denmark, Øster Voldgade 10 G, Copenhagen K, Denmark. Those

who have registered and paid the registration fee will receive the proceedings of the symposium free of charge.

The following social events have been planned :

Monday evening, June 25th — Reception by the Mayor of Lyngby at the Town Hall in Lyngby ;

Wednesday (whole day), June 27th — Tour to North Zealand including a visit to The State Experimental Farms Favrholm and Trollesminde near Hillerød, lunch at Marienlyst, Elsinore, and visits to Kronborg Castle, Elsinore, and to the exhibition of modern art at Louisiana where coffee will be served, price : 50 D.cr. ;

Thursday evening, June 28th — Banquet at the restaurant Nimb in Tivoli, price 60 D.cr.

The social arrangements described above are open also to ladies accompanying the participants, and the tour to North Zealand also to accompanying children. The tour and the banquet should be paid at the registration desk before Tuesday, June 26th, at 11 a. m.

A special ladies' program will be arranged.

Additional Symposium

The Symposium on Electromagnetic Theory and Antennas in Copenhagen will be followed by a Symposium on Interaction Phenomena in Plasmas, July 2 to 4, 1962, at Chalmers University of Technology in Gothenburg, Sweden. The Gothenburg Symposium will deal with some aspects of plasma physics which will not be discussed extensively in Copenhagen.

Registration forms for the Gothenburg Symposium can be obtained by writing to the Secretary General, Dr. H. Wilhelmsson, Research Laboratory of Electronics, Chalmers University of Technology, Gothenburg, Sweden.

INTER-UNION COMMITTEES

Radio-Meteorology

REPORT OF A MEETING HELD IN PARIS, APRIL 5, 6 AND 7, 1961

1. — Introduction

This meeting of the Inter-Union Committee was the first full meeting since the constitution of the Committee, although a preliminary meeting of those able to attend had been held previously at the time of the XIIIth. General Assembly of U.R.S.I. in London in September 1960. The following members attended the Paris meeting :

Professor J. S. Marshall (*Chairman*),
Mr. B. R. Bean,
Dr. R. Bolgiano,
M. P. Misme,
Dr. K. Naito,
Dr. Y. Ogura,
Professor P. A. Sheppard,
M. J. Voge,
Dr. A. T. Waterman,
Dr. J. A. Saxton (*Secretary*).

The remaining two members of the Committee, Dr. R. L. Smith-Rose and Dr. A. M. Oboukhov were unable to attend and sent apologies.

The following consultants also took part in the discussions :

Dr. K. S. Gunn,
Mr. F. J. Hewitt,
Dr. T. W. Wormell.

Between the preliminary meeting in London and the meeting in Paris the full membership of the Committee had confirmed the

choice of those members meeting in London of Professor Marshall as Chairman and Dr. Saxton as Secretary.

The proceedings on the 5th April were opened by M. A. Perlat, Inspector General of Meteorology, representing the French National Committee of U.G.G.I. M. Perlat welcomed the Inter-Union Committee to Paris and expressed the hope that its work would prove to be fruitful. In reply the Chairman said how pleased and grateful the Committee had been to accept the kind invitation to hold the meeting in Paris.

2. — Scope of the Committee's Work

In opening the scientific discussions, Professor Marshall commented that the Inter-Union Committee is founded in an observed need rather than from any logical foundation, and that the need perhaps lies in the physical nature of things. The parameters of radio are different in nature from those of meteorology, and there are subtleties in the relation between them : the behaviour of the troposphere as a medium for radio propagation is something more than meteorology. Temperature and water vapour contribute quite differently to the refractive index that is fundamental to propagation than they do to the density that is fundamental to fluid mechanics.

The first point considered was what upper boundary, if any, in the atmosphere limited the scope of the Committee's activities. In this connection the Secretary read a communication from Dr. Smith-Rose, President of U.R.S.I., in which it was emphasized that, as the successor to the former Joint Commission on Radio-Meteorology, the Inter-Union Committee — with its enhanced status and scope — has much important work to do on the overlapping borders of meteorological and radio science. Further, that the Committee and its activities are not necessarily to be confined to those of Commission II of U.R.S.I. which deals with radio and the troposphere. Dr. Smith-Rose drew attention to the fact that both meteorologists and radio scientists are concerned very much with thunderstorms and the electrical disturbances which accompany them, and also that meteorologists are becoming increasingly interested in phenomena occurring in the upper atmosphere, extending into the ionospheric regions. The Chairman said that he had sought the views of Dr. Warren Godson, Secretary of the I.A.M.A.P.,

on this particular matter, and that Dr. Godson had argued quite constructively that the atmosphere is all one, and that this should be reflected in its dynamic meteorology : one would not expect significant differences in turbulent structure, on the micro- and mesoscales, between different height levels. Moreover, the concepts and precepts used to describe and explain the synoptic entities, on the micro-scale, of the troposphere and lower stratosphere appear to have almost equal validity for the disturbances of the upper atmosphere : this suggests that the method by which energy is fed into the eddy spectrum is much the same at all heights below 120 km.

After discussion it was agreed that phenomena at ionospheric levels do properly fall within the scope of the committee, but that in the first instance consideration would be given mainly to matters relating to the troposphere : further, that a revision of the membership of the committee would be desirable before ionospheric-meteorological relationships were discussed.

The committee then agreed that its work was concerned with (*a*) aspects of meteorology which affect radio propagation, and (*b*) applications of radio techniques to meteorology additional to the propagation links involved in (*a*) [1] ; and that under (*a*) it would be relevant to discuss :

a - 1 The pattern of refractive index :

(i) systematic patterns of the refractive index such as the structure associated with horizontal stable layers ;

(ii) quasi-systematic patterns such as areas of uniform air-mass cumulus-cloud regimes with a nearly periodic arrangement of updraught and downdraught regions ;

(iii) random patterns such as those envisaged in turbulent scattering ;

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[1] The inclusion of the clause « additional to the propagation links involved in (*a*) » was strongly urged by Dr. Bolgiano, who emphasized the fact that propagation links yield information about meteorology ; that it is on that account that they are operated by many radiometeorologists, and that they must therefore be included in any list of radio techniques applicable to meteorology.

(iv) special patterns such as those associated with a clearly delineated front or the boundary of a sea breeze.

a - 2 The distribution of attenuating media ; water vapour, cloud, rain.

a - 3 Lightning (by the interference it creates).

a - 4 In the ionosphere : aurorae, winds, meteors. (But not at present.)

a - 5 Correlation of Satellite Weather Data with radio propagation.

a - 6 Tropospheric and stratospheric winds ; severe storms.

Concerning (*b*) the following topics should be considered :

b - 1 Radiosondes, rawinsondes and microwave refractometers.

b - 2 Radar observations of :

(i) the precipitation pattern,
(ii) lightning,
(iii) the dielectric pattern,
(iv) winds, by Doppler shifts of echoes from precipitation, index inhomogeneities or « chaff. ».

b - 3 Radio-location of lightning :

(i) by normal sferics techniques,
(ii) by radar receivers.

b - 4 Microwave radiometers.

b - 5 Meteorological interpretation of propagation performance in terms of the dielectric pattern.

b - 6 Meteorological interpretation of attenuation in terms of water-vapour, clouds, precipitation.

b - 7 Planetary atmospheric experiments and their testing on earth satellites.

The committee turned its attention first to topics falling under the general heading (*a*) above.

3. — Aspects of Meteorology which affect Radio Propagation

3.1. — *Turbulence and Atmospheric Inhomogeneities*

Dr. Bolgiano introduced a discussion on turbulence and atmospheric inhomogeneities ; he stressed the fact that turbulence in the atmosphere cannot be defined with the same precision as in the laboratory, and an answer is required to the question : « How complete are the current theories of turbulent mixing as regards inhomogeneities of refractive index in the atmosphere ? »

Dr. Bolgiano continued as follows. Homogeneous, isotropic turbulence, so familiar to the wind-tunnel aerodynamicist, is undoubtedly a rarity in the atmosphere. When it does occur, it is surely confined to rather limited regions in space and time, and even there it may have true meaning only with regard to the high wave number (very small scale) components in the velocity spectrum. On the other hand, from daily experience one is aware of the presence at all times of some degree of irregular motion, no matter how quiet the air may appear. Such quasi-turbulence, and fully developed turbulence when it exists, serve primarily as a diffusing mechanism.

Consider, for example, an experience common to nearly everyone. A candle is extinguished in a quiet room or chapel. There is no noticeable wind or air current. Yet within a few tens of seconds, at most, one becomes aware of the pungent odour of the burning wick. If molecular diffusion alone were responsible, though one were only three metres removed, he would have to wait about four days to detect this occurrence.

If we exclude from turbulence such « organized » motions as the primary scales in convective overturning, internal jets, gravity waves, hill and mountain waves, and boundary-layer type instabilities, we must nevertheless concede that these large scale currents are accompanied, at the minimum, by some degree of turbulence. These latter motions may be highly anisotropic, having horizontal sizes that are far larger than those in the vertical. Perhaps some people will prefer to consider them as random, coupled, internal gravity waves. The name is not important. What is important is the mixing they effect of passive properties of the atmosphere, such as the refractive index. This mixing is a direct

consequence of the irregular vertical nature of the flow. The resulting variations of refractive index will reflect the structure of this flow and will exhibit a spectrum induced thereby.

Whether one considers such irregularities to be anisotropic, turbulent blobs or somewhat rough, stratified layerettes, the electromagnetic energy that is reflected will be determined, at each instant, by the amplitude of that spectral component in the refractive index fluctuation spectrum for which

$$\underset{\sim}{k} = \underset{\sim}{k}_T - \underset{\sim}{k}_R$$

where $\underset{\sim}{k}_T$ and $\underset{\sim}{k}_R$ are the propagation vectors of the incident and reflected waves respectively. The total received signal is then the sum over all such reflections. The scale corresponding to k is determined by the geometry of the path and the radio wavelength ($L = \lambda/(4\pi \sin \theta/2)$). Consequently, the meteorological process (organized motion, quasi-turbulence, or fully developed turbulence) that is dominantly responsible for the structure of the spectrum in the interval sampled by a particular experiment will vary widely, both with changing meteorological conditions and from one experimental situation to another.

If even the quasi-turbulence is very weak (vertical motion highly damped by intense stability), and if L is large, the spectral intensity may be essentially that of the primary irregularities, those produced by the « organized » motions. In such cases the spectrum may typically be exponential in form, exhibiting a very rapid decrease with increasing k.

If there is moderate quasi-turbulence, but no fully developed turbulence (negligible micro-scale motion), one expects a stirring effect, evidenced by « streaking » were dye injected, but little or no turbulent diffusion. The edges of « streaks », dissipated only by molecular diffusion, will remain sharp for long intervals. An analysis similar to that which Batchelor has given for the case in which the kinematic viscosity is large compared to the diffusivity is appropriate for large k. Thus for small L the spectrum of irregularities will be that corresponding to sharp interfaces, i.e., inversely proportional to k. For large L it will depend upon anisotropic mixing induced by the quasi-turbulence. Little can be said about this at the present except that it must reflect a balance

between those forces responsible for the anisotropy (stability) and the inherent tendency of turbulence toward isotropy.

A k^{-n} dependence, with n greater than 2, seems likely.

In intensely turbulent cases the Kolmogoroff-Obukhov mixing theory should apply with the spectrum proportional to $k^{-5/3}$.

Obviously much remains to be accomplished, both in the fluid dynamics of stratified flows and in the description of the refractive index irregularities induced in such situations.

The following points were made in general discussion.

Dr. OGURA. — Observation of turbulence in the free atmosphere is of the greatest importance ; it is the primary source of our information, for the theoretical approach to the problem is extremely difficult. We do not even have a complete picture of turbulence in the shear flow of an imcompressible fluid as it occurs in the laboratory, and the tropospheric problem is more complicated due to the fact that the atmosphere is a stratified fluid. It would of course be valuable to have measurements of fluctuations of all of the physical variables, velocity components, temperature, humidity and refractive index ; but for radio propagation problems the refractive index is the most important quantity ; and it must be remembered that three-dimensional measurements are required.

Professor SHEPPARD. — The situation at the present is that the techniques almost exist whereby the micro-structure of the atmosphere may be measured. Meteorologists, however, need to be told (in fact they must be told more effectively) just what information the radio problems demand. The gathering and interpretation of the required data will constitute a very large programme of work, and this must be properly justified to the meteorologist.

In underlining Professor Sheppard's plea for a well-defined statement of the meteorological information required, Dr. Saxton stressed the point that an impressive amount of recent radio evidence appears to be at least partially incompatible with isotropic scatter theory. It would seem that layered structures, possibly very much thinner than present meteorological measuring techniques are able to resolve, may frequently play a significant role. He added that it must be realised that so far meteorologists have not, in the main, studied in any detail those characteristics of the troposphere which are of importance in radio wave propagation. Experience

has shown that it is frequently dangerous to try to deduce the information required in propagation research from existing meteorological knowledge obtained with another end in view. The radio scientist has had to provide himself with tools to investigate those features of the troposphere which concern him deeply — since they were not forthcoming from the meteorologists, in particular the microwave refractometer and radar ; and it is with further refined applications of tools such as these, together with radiometers, that the radio research worker may expect to acquire much of the information he still requires. There is, however, a bonus here for the meteorologist too, since these tools may also be used for other studies of particular interest to him. The Inter-Union Committee can serve a most valuable purpose in clarifying the issues thrown up by the study of radiometeorology and by getting rid of difficulties introduced by a too casual mixture of meteorology with radio (which has often so far bedevilled progress).

3.2. — *The Role of Radio Climatology*

This topic was introduced by Mr. B. R. BEAN, who described the problems confronting the radio propagation engineer in the design of telecommunication systems subject to tropospheric influences. The engineer wishes to know what minimum level of fields he may be expected to receive. He must know, within stated tolerances, if his system will work for some stated percentage of the time. This is a formidable undertaking for the case of VHF-UHF telecommunications via the troposphere. He is not required to predict the signal level at a given hour for some day in the distant future. Extensive examination of transmission loss data have shown decided dependence upon equipment characteristics such as antenna design and physical height above the ground, terrain characteristics and climatic region. For example, long term median value of transmission loss (which removes antenna effects) recorded over a given distance may vary as much as 75 db from one radio path to the next. Thus the radio scientist is encouraged to rest upon his knowledge of observed fields : i.e. prediction processes are largely empirical. It is true that much theoretical knowledge is available to guide the radio scientist in determining what parameters are important for the development of prediction processes.

When considering meteorological effects there is the additional requirement that the information be readily available and not too complex.

Fortunately, a rather simple guide is offered from the theory of atmospheric refraction. It has been long recognized in the field of astronomy that for large initial elevation angles the total refraction of a light beam passing completely through the atmosphere is independent of the refractive index structure along the ray path and is essentially determined by the refractive index at the earth's surface. The radio scientist has been cautious about applying this result for two reasons : (1) the refractive index at radio frequencies is sensitive to water vapour while the optical refractive index is far less so, and (2) transhorizon telecommunications are normally carried out for very low initial elevation angles.

The prospect of space telecommunications has revived interest in high-angle refraction of radio waves with the result that examination of available data indicated that the surface value of the refractive index could profitably be used to predict total atmospheric refraction for initial elevation angles as low as 10 milliradians. Experimental confirmation of this hypothesis by use of radio sextants has been most impressive.

It has been felt for some time that a similar approach could be used to aid in estimating climatological effects upon trans-horizon telecommunications. Experimental verification, in the form of consistent correlation between monthly median transmission loss and the surface value of the refractive index, has been found for many parts of the U.S., the Mediterranean, Japan and South America. In spite of this, radio theorists have still relied upon empirical methods to predict the time-variability of transmission loss. The surface value of the refractive index has only been used in the past for predicting the geographical variation of long term median transmission loss, in a manner involving the use of model atmospheres completely defined by this surface value.

For these two practical applications, the prediction of geographical variation of long term median transmission loss and the total refraction of high-angle radio waves, climatic charts and tables of the surface value of the radio refractive index have been found to be useful and have been prepared for the United States. The International Consultative Committee for Radio is now considering the

preparation of similar maps on a world-wide basis. Intensive work is being carried out all over the world to reveal the meteorological dependence of the different propagation mechanisms with the objective of developing a radio climatology based upon the synthesis of propagation mechanisms and thus more fully explain the time variability of transmission loss than does the present empirical approach. It appears this will occupy the radio meteorologists for some years to come.

In the ensuing discussion Professor Marshall said that, whilst the refractive index parameters currently in use in studies of the kind described by Mr. Bean should clearly be exploited as far as possible, this should not hinder the search for better — and possibly more physically realistic — parameters, a point of view strongly supported by M. Misme. The latter also commented on the very wide range of phenomena which could properly be embraced by radio climatology including, in the broadest sense, some aspects of ionospheric studies; and he considered that ultimately the radio climatologist might be expected to supply to radio scientists and engineers information relating to the spatial and temporal variations of all the atmospheric parameters of interest. This view was generally agreed by the Committee.

3.3. — *Tiros (Weather) Satellite and Propagation*

Dr. Waterman remarked that one of the aims of this committee should be stimulation of the application of new techniques or new information in one field — radio, or meteorology — to the other. The information obtained by the TIROS satellite — photographs from above covering large areas — is new data. As such it should be exploited to the fullest. It should not be left to the weather forecaster alone. It should be compared with other type meteorological data, particularly new radio-meteorological data such as those obtained in microwave radiometric measurements of noise from the atmosphere's absorbing constituents. It should be utilized in radio climatology for a possible correlation with radio propagation conditions.

All these points are admittedly qualitative and have the unsatisfaction and even danger associated with purely empirical investigations; nevertheless they should not be overlooked. New data

should always be examined even if only to stimulate imaginative thought.

The Committee welcomed Dr. Waterman's suggestion, and agreed that it should be borne in mind in future work.

3.4. — *The Pattern of Refractive Index*

Dr. WATERMAN opened a short discussion on the classification of patterns of refractive index, and recalled the comment by Professor Sheppard that the refractive index of the atmosphere in itself is not of interest to the meteorologist, except insofar as it reflects the distribution of temperature, pressure and water vapour. For the radio man, he continued, the emphasis is the other way round. The following classification, falling within the general category, « aspects of meteorology which affect radio wave propagation », is based on the refractive index, rather than the physical quantities which determine it.

A basic classification of this sort would first have to distinguish between the three phases in which at least one atmospheric constituent may be found :

gaseous (air, water vapour),
liquid (rain, clouds),
solid (ice, snow ; (ground(?)).

The last two are of concern primarily to weather radar, though the role they may play in forward propagation perhaps tends to be underestimated. Within the first, several distinctions are possible, and Dr. Waterman proposed a fourfold subdivision :

(i) systematic structures (layers, inversions) ;
(ii) quasi-systematic or semi-periodic structures (alto-cumulus formations) ;
(iii) irregular or random structures (turbulence, of various types) ;
(iv) frontal structures (weather fronts, seabreeze boundary, etc.)

Clearly, this classification is arbitrary. It could be broken down into just two : systematic and irregular. Alternatively, it could be subdivided more finely. The reason for selecting the above arrangement is the belief that it reflects some propagational distinctions of importance. Refraction and ducting by well established layers is certainly an accepted phenomenon. Turbulence is strongly

invoked to explain transhorizon propagation. There are also propagational measurements which do not fit either of these extreme cases, but which sometimes have characteristics indicating an admixture of both, as pointed out by M. Voge, and sometimes imply a structure midway between the two. The fourth category is distinguished from the first in that it applies to non-horizontal structure, and consequently affects radiowave propagation in a different type of application ; it also reflects a different physical phenomenon.

It is also possible to extend the classification, as suggested by Dr. Bolgiano, to include structures of a greater scale and more extensive influence. This extension would include winds and severe storms.

Dr. NAITO. — In supporting the general ideas on classification put forward by Dr. Waterman, commented further on the characteristics of quasi-systematic patterns and random patterns. Usually the smaller scale patterns tend to persist for shorter periods than the larger scale ones, so that the former are more like random patterns when considered over a long period of observation, even if on a short term basis they are regarded as quasi-systematic. In the classification of patterns, therefore, it is essential to specify the period of sampling. M. VOGE also pointed out that it was desirable to study the processes of transition between stable layers and turbulent regions.

Dr. BOLGIANO contributed to the discussion with remarks on winds and severe storms. Winds affect the propagation of radio waves in two ways : (i) indirectly, as one of the primary agents responsible for the nature of the refractive index pattern ; and (ii) directly, via the Doppler effect. He re-emphasized the fundamental role that dynamical meteorology in general plays in the propagation of radio waves everywhere in the atmosphere. As for the Doppler phenomenon it is, of course, principally responsible for the fading of received fields. This is of consequence from the communication engineer's point of view. The possibility of the meteorologist's deducing valuable information regarding the nature and structure of air currents via this effect must not be underemphasized.

Concerning severe storms, here a vast quantity of meteorological information has been gathered by means of weather radar but

only a very modest amount of data have been collected relevant to radio propagation through or in the immediate vicinity of such meteorological events. It seems not unlikely that there are effects, as yet largely unappreciated, which may be significant communication-wise, as well as helpful to the meteorologist. For example, the wall of a hurricane is remarkably free of turbulence in spite of the intense velocities to be found there. This may be attributable to the predominantly two-dimensional character of the vortical flow associated with such a storm. Even in the absence of a high degree of turbulence one cannot neglect the possibility that the primary vortex itself, and the humidity distribution associated with it, may be responsible for radio phenomena of some considerable magnitude. If a fundamental study (either theoretical or experimental) into the nature of these effects has been made, the results should be widely disseminated. If not, then a preliminary study deserves to be made forthwith.

Finally, it should be noted that it may be possible to detect and study the development of weather situations on the synoptic scale through the observation and analysis of radio wave propagation. Variations in refraction, absorption, and reflection (scattering in general), when properly identified and distinguished, may yield useful information on air mass properties and structure, as well as their evolution in space and time.

3.5. — *Summary Discussion*

In summarizing the discussions so far Professor SHEPPARD emphasized again the need for a clear statement from radio workers on what information was thought to be required from the meteorologist, and asked, in relation to this problem, for a comprehensive review to be prepared describing current experimental experience and theories of tropospheric propagation. Whilst the atmospheric refractive index is not an interesting meteorological variable, it depended upon temperature and humidity mixing ratio which are, and these exhibit variations on all scales down from global to ones of the order of a centimetre ; further, an understanding of these variations requires some understanding of synoptic meteorology — but not necessarily of weather forecasting.

Concerning systematic patterns of refractive index, such as diurnal variations in the lowest kilometre of the atmosphere, sub-

sidence inversions, air-mass modifications, sea-land and sea-breeze changes, Professor Sheppard said that these structures are broadly understood and forecastable in weather and climate. However, the sharpness of gradients of refractive index likely to occur are not known, and here the assistance which can be obtained from rapidly responding radio refractometers will be important.

Random and quasi-systematic patterns, on the other hand, are associated with smaller scale variations than systematic patterns ; knowledge of these is rather scanty and understanding of them even more so. There is no one spectrum which describes such variations, the effective spectrum at any time depending upon the degree of stability of the atmosphere, and how systematic the pattern is. Professor Sheppard concluded that much further research is required by meteorologists and radio scientists alike once the complete nature of the common problem begins to be established.

Dr. WATERMAN remarked that, whilst it may be true in principle that the systematic structures which occur in meteorology are understood, there is nevertheless a need for better quantitative measurements of the associated radio refractive index variations. We need, for example, to know the extent and abruptness of discontinuities in layers : we are generally interested in index changes occurring over distances as short as a centimetre, and in variations of the order of one part in 10^5.

Professor MARSHALL considered it important that anyone carrying out tropospheric radio propagation research should avoid two misapprehensions, namely : (*a*) that he needs to learn weather forecasting before he can study the meteorology of propagation, and (*b*) that, because a man is a good weather forecaster, he can be expected to know the pattern of refractive index, and so to proceed without hesitation to discuss or study problems of radio propagation. He emphasized that these problems require for their solution the support of scientists studying the pattern of refractive index of the atmosphere, climatologic and dynamic, in all its ramifications, work which can properly be classified as physical meteorology.

4. — APPLICATIONS OF RADIO TECHNIQUES TO METEOROLOGY

The committee next turned to a consideration of the second broad division of its work, the application of radio techniques to meteorology.

4.1. — *Weather Radar*

After a few brief comments the Chairman asked Dr. Gunn to provide a more detailed introduction to this subject, which was as follows. Weather radar has the capability of revealing the precipitation pattern in three-dimensional steps, indicating the intensity at every point, and doing this every few minutes. Its range is limited to something like 120 nautical miles by the earth's curvature. Rain ranges in intensity from one tenth mm hr^{-1} to hundreds of mm hr^{-1}. Signals from hailstorms can be interpreted as rain of up to 1000 mm hr^{-1}, and are probably actually attributable to a relatively small intensity of large hailstones. At any rate, there is a wide range of intensities to be covered, so that the receiving equipment must have a dynamic range of between 60 and 70 db.

Weather radar has this capability, but in use it is falling far short of it because of :

(*a*) shortcoming in the development and maintenance of equipment, and

(*b*) the use of wavelength 3.2 cm at which attenuation by the precipitation itself is large.

The outstanding problem is to persuade all the meteorologists involved that radar will continue to fall disappointingly short of its potential unless these shortcomings are overcome.

In addition to locating and measuring precipitation, weather radar can do other things through specialised techniques. When attention is paid to polarising effects, information can be obtained about the shape of scattering particles. With Doppler radar, the mean speed or its component along the beam, and the internal motions of some scatterers relevant to others are revealed. This permits measurement of turbulence : if there are no precipitation particles in the turbulent atmosphere, clouds of radar scatterers can be released for the purpose. The sound of a tornado on Doppler radar is much like the real thing.

One of the notable contributions of weather radar used for research in the past ten years has been in the study of snow formation processes in the atmosphere. Currently it is making comparable contributions in the study of severe storms. The hurricane and the tornado have both been the subject of study, although

in the tornado case the role of the radar has been largely that of storm detector, and it has not added anything of significance to the physical picture. Most impressive is the rate at which radar, used in conjunction with surface observations of fall out, is presently providing evidence as to the nature of the hailstorm. And it is truly international undertaking, involving several different countries.

In severe storm study, one outstanding need is a technique for measuring the vertical currents, the updraughts and downdraughts, in the thunderstorms. It may be that radars of very high resolution would reveal the vertical motions of blobs of precipitation, or it may call for Doppler techniques.

As far as equipment is concerned, research and operational meteorology have much the same requirement. In both cases, the more the radar operation can be automated, the better. The research man needs to have his records produced automatically and continuously, without subjective manipulations at the whim of an operator. The forecaster requires the same records, on the same continuous basis, and he needs them within minutes. Automatic processing and transmission of weather radar data are required for other users within the area covered by the radar, and also for transmission to a central weather station for a much larger area. There is a need for automation in identification of severe storms, automatic computing of the relevant variables and the automatic triggering of alarms when pre-set critical levels are exceeded.

Lastly, regarding the need for people trained in both radar and meteorology, there are some doubts being voiced currently about the application of « Rayleigh » scattering theory to the case of microwaves and cloud droplets. When there are many scatterers per wavelength, the accepted notions of incoherent scattering may not be the whole story. This is a good example of a problem that requires study by someone knowledgeable in both radio and meteorology, who can see both sides of the problem.

There was some discussion as to whether radar weather studies fall properly within the scope of the committee's activities, but the strong arguments advanced by Professor Marshall and others made it quite clear that they do.

Dr. OGURA mentioned work in progress at the Massachusetts Institute of Technology in which radar observations of winds and

turbulence are being made : this work has so far provided information on the power spectra of winds, and on the vertical and horizontal dimensions of small-scale convective cells in precipitation areas. Radar observations of this kind form a further bridge linking the interests of radio scientists and dynamical meteorologists.

The usefulness of radar in making vertical soundings of the refractive index structure of the troposphere was discussed by Dr. SAXTON. He said that most interesting results had already been achieved by this method, and he felt that, with improving overall radar performance, even finer details of structure would be revealed. Dr. WATERMAN remarked that in meteorological measurements it is important not only to increase the number and quality of observations made at a point in space, but also to give consideration to means of measuring refractive index structure directly. For example, a surface of discontinuity is difficult to delineate on a point-measurement basis, yet it shows up quite clearly with radio-reflection techniques — as in radar reflections from a seabreeze frontal surface.

4.2. — *Radar observations of Sferics and Lightning*

Mr. HEWITT gave an account of the reception by radar receiving systems of the radio noise radiated by lightning discharges. With long-range radars, operating at a wavelength of 10 cm or longer, the distance over which reception is possible is mainly limited by the curvature of the earth. However, the probability of detection of an individual sferic at very short wavelengths is very low due to the narrow beamwidth of the radar aerial and the short duration of the sferic. It could thus be argued that conventional microwave radar systems are not really suitable for observing sferics : longer wavelength systems of comparable receiving aerial aperture, and therefore with wider beams, would be more suitable, but the probability of detection would be increased at the expense of accuracy of bearing determination. It is by no means certain that such a system would be superior to a fixed aerial direction-finding system operating at a still longer wavelength.

As opposed to the simple reception of sferics by a radar receiver discussed above, the true radar observation of lightning has the distinct advantage that the range as well as the bearing of a single

lightning discharge can be obtained with a high degree of accuracy. Certainly at all the longer radar wavelengths commonly used both ground and cloud discharges may be observed by high-performance systems, at ranges limited largely by the earth's curvature. The probability of detection is again low, but not as low as that for simple reception of the sferic because of the duration of the radar echoes. What the source of these echoes is remains to be determined, but Mr. Hewitt expressed the personal view that they are predominantly due to the so-called junction streamers.

4.3. — *Microwave Radiometers*

The essential features of a microwave radiometer, and its possible applications in meteorology were described by Dr. WATERMAN as follows. The basic elements of a microwave radiometer are a « good » antenna, a short lowloss transmission line and a sensitive receiver. The output of the receiver is a voltage of noise-like variation. It is interpreted in terms of a noise temperature. — the apparent temperature associated with a thermal noise generator. The noise temperature indicated by the receiver output contains contributions from several sources : the receiver itself, ohmic losses in the transmission line and antenna, thermal radiation from atmospheric absorbing agents and galactic noise. In the microwave portion of the spectrum, galactic sources contribute only a small amount of noise. By proper design ohmic losses can be kept small. An extremely sensitive receiver such as a maser or parametric amplifier is used. The « good » antenna required is one which discriminates strongly against radiation arriving from unwanted directions, primarily earth radiation with an associated noise temperature around 300° K.

Using equipment of this sort at 6 kMc/s, the Bell Telephone Laboratories have measured atmospheric noise temperatures amounting to 3° k on a clear day, 7° k on a « wet » day and 20° k during a rain storm. They have reported poorer correlation than expected between atmospheric noise temperature and rain at the surface ; they have noted a precursor effect : rise in noise temperature preceding local rain.

Clearly this type of observation is of interest to the meteorologist, both as regards interpretation of the results and as regards a new

technique for measurement. In this last connection, it should be noted that the BTL experiment is being performed to determine one of the factors which will influence satellite communications. The frequency is chosen for good penetration of the earth's atmosphere. As a meteorological too, or for purposes of basic research, other frequencies might be more interesting, particularly a set of frequencies, each lying on or near an absorption line of an atmospheric constituent. It should also be noted that the expensive maser receiver can be circumvented through use of switching techniques and long time integration, as is done so frequently in radio astronomy.

4.4. — *Radio Refractometers*

Dr. BOLGIANO introduced a discussion of the applications of radio refractometers. Remarking that several references had already been made to the use of such refractometers, together with rapid-response thermometers mounted directly thereon, as fast-acting devices for the measurement of humidity, and that Professor Sheppard had commented on their use in the study of refractive index microstructure, including spectral analysis, Dr. Bolgiano said that he now wished only to lay additional stress on this latter application. The inherent sensitivity of the refractometer makes it a valuable tool with which to investigate atmospheric microstructure. However, in translating such data into spectral form it is important, as stated by Dr. OGURA, that the three-dimensional and inherently anisotropic nature of atmospheric processes not be overlooked.

For example, the spectrum of refractive index fluctuations detected by essentially horizontal flight of an airborne refractometer probably is not relevant to the analysis of transhorizon radio propagation, in which reflection occurs via a Fourier component for which the wave number vector is vertical. Moreover, the spectrum derived from data gathered using a drop-sonde or rocketsonde would not be directly relevant either. In principle the three dimensional structure must be determined (or deduced), and it is for this reason that simultaneous three-dimensional investigations, such as that currently being undertaken by M. C. Thompson at the National Bureau of Standards, Boulder, should prove exceeding valuable, provided collection of essential meteorological data is also

undertaken. If the anisotropic nature of small-scale atmospheric structure can be related to temperature gradient, wind shear, and synoptic weather features, this will represent an advance of some appreciable import.

In the general discussion of the applications of refractometers, Dr. Waterman commented on the importance of considering the merits of a relatively cheap expendable instrument which would be applicable to balloon-borne measurements on a wide scale. Such a device might well follow the pattern of the expendable refractometer developed at the University of Texas, in which as great a proportion as is possible of the total equipment is kept on the ground and is therefore not expended. Devices of this kind could truly be described as refractosondes.

5. — Presentation of Papers on Recent French Research in Radiometeorology

The morning of the 6th April was devoted to the presentation and discussion of three papers describing recent research in France and falling within the field of interest of the Committee. Brief summaries of these papers follow.

5.1. — « *Radiometeorological Structure of the Atmosphere deduced from Frequency Swinging on a Trans-Horizon Path* »

by J. C. Simon and A. Spizzichino

The paper begins with a description of a transmitter and receiver designed to operate at frequencies near to 3000 Mc/s : carcinotrons in the two terminal equipments swept in frequency in synchronism permit the examination of propagation characteristics over a band of 200 Mc/s in 1/20th of a second. The results of observations extending over a year for a 300 km path have been analysed.

It is shown that the spectrum of the fluctuations of the received signal as a function of frequency is related to the volume distribution of scattering or reflecting atmospheric inhomogeneities. The observed spectra demonstrate the existence of both reflection by one or several layers and inhomogeneous « volume » scattering.

This kind of investigation permits the determination of the bandwidth of signals which may be transmitted over a trans-horizon path and also the influence of aerial beamwidth. Finally the possibi-

lity is indicated of designing a trans-horizon link for which the frequency of operation is chosen at each instant to be that for which minimum attenuation occurs in a wide frequency range. The gain in sensitivity thus obtained would be superior to that which can be obtained by means of conventional quadruple diversity reception.

(This paper is to be published in *Annales des Télécommunications*.)

5.2. — « *The Influence of Equivalent Gradient and Atmospheric Stability on Trans-Horizon Links in the Sahara and Congo* »

by P. Misme

The paper presents first an experimental study of propagation at a frequency of 471 Mc/s over a 160 km path in the Sahara. Existing classical radiometeorological parameters are shown to be inadequate for the explanation of the results obtained. The theory of diffuse reflection is discussed and the superiority is demonstrated of other different parameters related to the state of stability of the atmosphere. It is then shown how one can use these parameters to calculate field-strength characteristics, and the theory developed is shown to account well for further experimental observations at 471 Mc/s over a 300 km path in the Congo.

(This paper is to be published in the *Spanish Review « I.N.E. »*.)

5.3. — « *Synoptic Variation of the Equivalent Gradient in the Mediterranean* »

by P. Misme

The parameter « equivalent gradient » is discussed and an experimental method described whereby its limits may be defined. With the help of a film presenting several days' radar observations of a distant land echo (over a sea path in the Mediterranean), it is shown that the equivalent gradient varies slowly, and that the extent of the zone over which little variation occurs is comparable with the extent of air masses. It is further shown that there exists at times a rapid variation of small amplitude related to turbulence in the atmosphere.

(This contribution was simply a commentary on the film referred to, and will not be published.)

6. — Visit to « Centre d'Etudes de Recherches Météorologiques »

In the afternoon of 6th April the Committee visited the above laboratory at Magny-les-Hameaux to see some of the research in progress, and in particular examined the observations of the speed of fall of raindrops being made by radar using the Doppler effect.

7. — Concluding Discussions

The concluding discussions of the committee on the 7th April were concerned with summarizing members' views on the scope of the committee's activities, defining as clearly as possible the way it should fulfill its duties, and deciding what course of action should be taken in the immediate future.

7.1. — *Statement by the Chairman*

Professor Marshall made the following statement. « In discussion by memoranda before arriving in Paris, and in the meeting on Wednesday (5th April) it was thought generally desirable that the committee through its actions should bring together scientists whose common interest is the atmosphere. Just what groups should be brought together ? Since Wednesday's discussion it has become apparent that the answer is already contained in the agreement drawn up between U.R.S.I. and I.U.G.G., which states that the aims of the committee will be :

(*a*) to further the study of those aspects of meteorology which affect radio propagation, and

(*b*) to further the application of radio techniques to meteorology.

The committee could act most constructively by bringing together the students of (*a*) and the students of (*b*), both of these groups being appropriately known as radiometeorologists. The requisite knowledge for work is much the same in (*a*) and (*b*), a knowledge of the processes of physical meteorology and of that branch of radio which might be described as physical optics at radio (particularly microwave) frequencies.

The scientists of group (*a*) are reasonably coherent in their interests, although tending to be somewhat divergent in their interpretation of observations. They are diffident about describing

themselves as radiometeorologists, taking the attitude that they are radio scientists who will one day find a meteorologist who can describe for them atmospheric structures and dynamics which will explain their observations.

The scientists of group (*b*) are somewhat less coherent in their interests, although two sub-groups would probably cover most of their activities, concerned with : (*b*1) radar studies of weather, particularly of precipitation, and (*b*2) the study of lightning, principally by radio. Workers in group (*b*) are more likely to accept the title of « meteorologist ».

Research in group (*a*) involves an association with specialists in the study of turbulences, whilst research in group (*b*) involves common group with cloud physicists and meso-meteorologists. From this it might possibly be argued that an alternative formula for the co-ordination of activities would be more realistic, that is group (*a*) associating with non-radio turbulence specialists on the one hand, and group (*b*) associating with non-radio specialists in cloud physics and meso-meteorology on the other. This kind of association does occur, and will inevitably continue to do so, and past experience tends to suggest that the two radio groups have less affinity for one another than they have for their non-radio collaborators. Whilst this alternative grouping certainly merits serious consideration, it is doubtful if it would be wise for the committee as at present constituted to attempt to organize these separate activities unless at the same time there were some other activity to provide a powerful bond between groups (*a*) and (*b*).

We return therefore to the problem of fostering a fruitful union between the workers of groups (*a*) and (*b*). The Conference on Radiometeorology held at the University of Texas in 1953 had this objective in view, but was not really too successful, for the individuals working in the two fields embraced by our terms of reference tended to confine their attention very much to their own particular problems. Nevertheless, because there is so much to be gained from sharing our common interests in the atmosphere and its processes, the primary aim of this Inter-Union Committee should be to establish a powerful new coalition of radio physics with a broad related spectrum of physical meteorology by bringing together the scientists of groups (*a*) and (*b*), including the turbulence specialists associated with (*a*) and the cloud-physicists asso-

ciated with (*b*). The greater breadth of knowledge required by all concerned will be beneficial to all parties, and to scientific advance generally. Such activity by the committee would not conflict with existing activities under U.R.S.I. and I.U.G.G. individually. Radiometeorologists will find themselves involved in the proceedings of both Unions, but will find added strength in sharing a title and extended field of knowledge with colleagues of wide-ranging interests. »

The committee expressed general agreement with the Chairman's foregoing remarks and, after further discussion in which the point was made that it would be undesirable to attempt to specify the committee's terms of reference in too precise detail, it was confirmed that these terms should be simply as stated in the memorandum of agreement drawn up by U.R.S.I. and I.U.G.G. when the Inter-Union Committee was formed.

7.2. — *Future Course of Action of the Committee*

Discussion concerning the committee's future course of action centred round the Chairman's statement recorded above and memoranda submitted in advance of the Paris meeting by various members. It was decided to seek permission from the Parent Unions to hold two meetings : (i) a general scientific conference to bring together all kinds of radiometeorologists, and (ii) a specialized symposium, in which a limited number of experts would take part, on the fine structure of the atmosphere relevant to radio propagation problems.

It was considered that, in view of the great development in, and ramifications of, the whole field of radiometeorology in recent years, a general meeting of the kind (i) above would serve a most valuable purpose. It was further felt that at this meeting an attempt should be made to get together a representative international gathering of people interested in the broad aspects of radiometeorology, and that strenuous efforts should be made to avoid a division of the conference into small groups discussing narrow sectional interests. It was agreed that a suitable time for this conference would be in the period between the General Assemblies of U.R.S.I. and I.U.G.G. in 1963, and that it should be held in the United States of America, possibly at the National Bureau of

Standards, Boulder, Colorado, or otherwise in California. A committee to organize the conference was set up under Professor Marshall as Chairman, with Mr. Bean and Dr. Wormell as members ; additional members to be co-opted at the discretion of the Chairman. In making their arrangements, the organizing committee were asked to take into consideration the activities of the American Meteorological Society in this field.

There was strong support for a specialized symposium of the kind (ii) above, and it was generally agreed that the greatest success would be achieved by getting together a quite small group of experts to discuss in detail certain clearly defined problems : attention should be focussed on what is meteorological sound in the theory of radio wave propagation, and on where radio and meteorological experiments are failing to yield the information required. A proposal was made that the possibility of holding this symposium in the U.S.S.R. should be explored, perhaps in Leningrad, otherwise a suitable place would be Cambridge, England ; and early in September, 1962, was considered to be an appropriate time. Dr. Bolgiano was appointed Chairman of a committee to organize this symposium with Dr. Ogura and Dr. Saxton as members : the hope was expressed that Dr. Obukhov would also participate in the work of the organizing committee, and Professor Sheppard agreed to nominate an additional member.

As a result of a suggestion made by the Japanese members of the committee, it was further agreed to try to arrange with the Chairman of Commission II of U.R.S.I. that strong emphasis should be placed on discussions of weather-radar problems and associated cloud physics at the meetings of the Commission at the time of the General Assembly of U.R.S.I. in Japan in 1963.

7.2.1. — *Report on Tropospheric Attenuation and Noise Radiation.*

The Committee agreed to ask Dr. Gunn to seek the collaboration of Dr. D. C. Hogg in the preparation of a report, for submission to the Chairman as quickly as possible, on the attenuation of radio waves and radio noise effects in the troposphere with special reference to their relevance to space communications. The report should contain an account of what is at present known about these phenomena, and should indicate that more might reasonably be expected to be ascertained by a further year's well-directed study.

7.2.2. — *Planetary Atmospheric Experiments.*

The subject of planetary atmospheric experiments was listed on the original agenda as a subject for discussion on the 5th April ; lack of time, however, unfortunately prevented Dr. Waterman from introducing the topic as planned. He reminded the committee about it during the consideration of possible future symposia on the 7th April, and was asked by the Chairman to put his views in writing for inclusion in the report of the meeting.

The following is Dr. Waterman's written contribution, reproduced of necessity without comment from the committee.

« I believe the subject of planetary atmospheres is one of direct concern to this committee. It is important first to recognize and accept a few broad facts. First, rocket-launched probes to investigate planets and their atmospheres are now being specifically planned. The U.S.S.R. has already launched one probe towards Venus. The U. S. A. will do so before much longer. These initial efforts will be followed by many others, with increasingly greater amounts of instrumentation. Some of the instrumentation, in certain programmes much of it, will measure the characteristics of planetary atmospheres. Radio methods will be used directly for some of these measurements. For all of them, the data obtained will be sent back to earth by radio.

Thus these planetary probes will be concerned directly with the meteorology of planets and with radio techniques for measurement. as well as for data transmission. More specifically, they will involve both (*a*) aspects of planetary meteorology which affect radio propagation — for example, in transmitting data from within the atmosphere of a planet or from its surface — and (*b*) application of radio techniques to meteorology — for example, in the measurement of microwave absorption bands within a planetary atmosphere. Consequently, their subject matter is in every respect of direct concern to this committee — unless we wish deliberately to keep ourselves earthbound.

Last year (June 24, 1960) the Space Science Board of the National Academy of Sciences held a Conference on Planetary Atmospheres presided over by Dr. L. V. Berkner, past President of U.R.S.I. (Reported in *Trans A.G.U.*, 42, 1, 9-38, Mar. 1961). At the XIII General Assembly of U.R.S.I. in London, in September, 1960,

Dr. Huxley suggested this subject as being of specific concern to Commission II. I do not believe this committee would be exceeding its bounds in considering it. In fact, I believe we would be remiss to disregard it.

There is not the time nor space here to survey the variety of measurements which could be, and in some manner or other undoubtedly will be, performed. Suffice it to mention a few by way of example. Much could be learned from a vehicle which goes into eclipse behind a planet — either on a fly-by or by being placed in orbit around the planet — by studying the manner in which various radio frequencies are attenuated, refracted and diffracted. Similarly radio soundings from a planetary satellite at spaced frequencies could yield much information. The same applies to transmission between a daughter probe penetrating the atmosphere and a mother probe in orbit. Alternatively a mother probe could drop off instrumented balloons to float in the atmosphere and make measurements.

Many of the measurements desired, particularly the early ones, will be relatively simple and basic : determination of surface pressure, measurement of the depth of Venus' cloud cover, and the nature of the clouds, analysis of atmospheric composition and temperature. It is not immediately obvious in all cases what the optimum method of measurement is which will yield a desired bit of data, — whether the measurement could best be made from the earth's surface, from an earth satellite from a planetary fly-by, from a planetary satellite, or from a planetary penetration.

In my opinion, this committee would serve an important function by calling the attention of those who may be conducting such experimentation to the interplay of two disciplines involved here. (Other disciplines also, of course, are involved which do not concern us). It is important that radio experiments have the benefit of meteorological knowledge, and vice versa. It is not too soon to start taking action. If we wait two years, many experiments will have been already performed, or at least committed, without the benefit of any co-ordinating suggestions which we could be making. »

7.3. — *Publication of Proceedings of the Committee*

The committee decided with little discussion that it would be sufficient to have accounts of mainly business meetings, such as the

present one, published in the *Bulletins of U.R.S.I. and I.U.G.G.*; though this would not prevent members from publishing brief accounts also in appropriate national journals if they so wished.

There was much more debate, however, on the publication of proceedings of symposia and conferences organized by the committee, and divergent views were expressed. Professor Sheppard, for example, said that he was in general opposed to the separate publication of proceedings of symposia because : (i) some at least of the material will have been published elsewhere, and duplication is bad ; (ii) many authors prefer their original work to be published in the standard journals of research ; (iii) it is difficult for contributions to symposia to be effectively referred ; and (iv) the publication of separate symposia proceedings usually takes longer than the publication of papers in standard journals. Whilst admitting that there may be certain symposia for which, in spite of the above factors, a single publication of proceedings might be desirable, Professor Sheppard said that such a procedure ought to be the exception rather than the rule. Dr. Bolgiano, on the other hand, considered that in as much as a small specialized symposium may well involve more informal discussion than formal presentation of scientific results, and in as much as the contributions contained in such discussion will probably constitute the most important part of the proceedings, the committee should commission the preparation of a special monograph summarizing the symposium.

The CHAIRMAN said that the really important consideration was that the proceedings of symposia and conferences should be made available as soon as possible and as widely as possible to those likely to be interested in them, a point of view strongly endorsed by M. Misme, who added that this might well involve simultaneous publication in more than one journal. It was finally agreed that each case should be considered on its merits, and not to propose any definite procedure which would be applicable to the proceedings of all symposia and conferences arising out of the activities of the committee.

7.4. — *Appointment of Additional Consultants*

There was some discussion concerning the appointment of further Consultants in the light of the specialist needs revealed by the

committee's consideration of the scope of its work : various names were mentioned and the Chairman and Secretary were left to take the necessary action.

8. — Closure of Proceedings

At the conclusion of the formal proceedings Dr. Bolgiano, on behalf of the committee, proposed a warm vote of thanks to the French hosts, both for the excellent arrangements which had been made to facilitate the work of the committee, and for the enjoyable visit to the Centre d'Etudes et Recherches Météorologiques ; a proposal heartily endorsed by the rest of the committee.

M. Decaux, speaking for the French National Committees of U.R.S.I. and I.U.G.G., said that he was pleased to see that the committee had made such a good start on its work in Paris and hoped that this was a happy augury for its future efforts.

RECHERCHE RADIOÉLECTRIQUE DANS L'ESPACE

Résolutions de l'U.A.I.

(English text : p. 71)

Au cours de sa séance de clôture, le 24 août 1961, l'Assemblée Générale de l'Union Astronomique Internationale a adopté deux Résolutions relatives à l'interférence possible de certains projets de l'espace et des observations astronomiques. J'ai été officiellement invité à attirer votre attention sur ces Résolutions, et à vous demander de déployer tous vos efforts pour que tous les Gouvernements répondent à l'appel figurant au dernier paragraphe de la Résolution n° 1. La Résolution n° 2, qui se rapporte à un projet spécifique, vous est communiquée uniquement pour information.

Le texte français de ces deux Résolutions est donné ci-après.

Cette communication est adressée :

a) aux Gouvernements, soit directement, soit par l'intermédiaire des Académies Nationales des Sciences ou autres organisations appropriées ;

b) à l'Organisation des Nations Unies ;

c) à l'Unesco ;

d) au Conseil International des Unions Scientifiques, à ses Unions Scientifiques et ses Comités Spéciaux ;

e) à l'U.I.T., l'O.M.M. et à d'autres organisations internationales gouvernementales et non-gouvernementales.

Septembre 1961.

Le Secrétaire Général (D. H. SADLER),

Union Astronomique Internationale
Royal Greenwich Observatory
Hertmonceux Castle
Hailsham, Sussex, England.

Résolution n° 1

(*traduction*)

Considérant avec une grande inquiétude certains projets de recherches spatiales qui pourraient compromettre sérieusement les observations astronomiques aussi bien optiques que radioélectriques,

persuadée qu'un degré de pollution de l'espace, à peine décelable actuellement, pourrait, s'il était durable, se révéler un jour désastreux pour les observations utilisant des techniques perfectionnées,

affirmant qu'aucune collectivité n'a le droit de modifier sensiblement l'espace au voisinage de la terre, sans un accord international fondé sur une enquête approfondie,

l'Union Astronomique Internationale *insiste* tout particulièrement pour que soient pris en considération les progrès futurs de l'astronomie, qu'il y aurait de graves inconvénients moraux et matériels à perdre de vue,

et *demande* instamment à tous les gouvernements engagés dans les expériences spatiales qui pourraient affecter la recherche astronomique, de prendre l'avis de l'Union Astronomique Internationale avant d'entreprendre de telles expériences et de ne procéder à aucun lancement sans qu'il soit établi d'une manière irréfutable qu'aucun dommage ne peut en résulter pour la recherche astronomique.

Résolution n° 2

(*traduction*)

L'Union Astronomique Internationale constate avec satisfaction que les plans du projet West Ford ont été annoncés publiquement bien avant l'époque du lancement projeté et que selon les intentions officielles [1] du Gouvernement des Etats-Unis, au sujet des expériences suivantes, de tels projets ne seront pas entrepris sans que des assurances suffisantes aient été obtenues qu'elles ne compromettront pas gravement les observations astronomiques.

Cependant, l'Union Astronomique Internationale considère avec la plus grande inquiétude le cas où la ceinture de dipôles qui fait

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[1] Lettre du 11 Août 1961, du Dr. J. B. Wiesner au Dr. L. Berkner.

l'objet du projet West Ford serait de longue durée et reste résolument opposée à cette expérience jusqu'à ce que le problème de la permanence ait été clairement exposé dans des publications scientifiques, un délai suffisant étant laissé pour son étude. L'Union Astronomique Internationale reste opposée aux expériences qui pourraient entraver les développements futurs dans l'astronomie.

S'il peut être prouvé que les dipôles auront une vie courte et que l'expérience ne présente aucun inconvénient, et si l'expérience West Ford est entreprise, l'Union Astronomique Internationale considère comme essentiel que les observations et les expériences les plus complètes sur les propriétés et le comportement de la ceinture de dipôles soient entreprises par tous les moyens possibles. Ces observations et ces expériences devront être exécutées et analysées au niveau scientifique le plus élevé et avec le meilleur équipement disponible, en considérant que des signaux à peine, ou non, décelables aujourd'hui pourraient compromettre gravement les recherches entreprises dans la suite avec des moyens de sensibilité accrue.

Il est probable que ces observations et ces expériences seront difficiles à exécuter, et seront à maints égards identiques à celles que les autorités responsables du projet entreprendront à l'occasion de l'opération West Ford. En outre, beaucoup de données, telles que des éphémérides précises et tenues à jour, seront nécessaires. L'Union Astronomique Internationale s'efforcera d'organiser une coopération rapide et efficace entre les observateurs et les calculateurs, et d'assurer la diffusion mondiale de leurs résultats conformément à l'usage en matière de recherche scientifique.

L'Union Astronomique Internationale apprend avec satisfaction que les décisions [1] du Gouvernement des Etats-Unis, relatives aux expériences ultérieures du type West Ford seront prises à la lumière des résultats de l'expérience actuellement en projet. Pour lui permettre de réunir les données nécessaires, l'Union Astronomique Internationale prie le Gouvernement des Etats-Unis de donner tous pouvoirs à un groupe d'astronomes agréé à la fois par le Gouvernement et par l'Union, pour coopérer avec les autorités West Ford en vue de déterminer par des expériences quantitatives les propriétés de la ceinture de dipôles, ses variations dans le temps et l'espace, et ses répercussions sur les recherches astronomiques présentes et futures.

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[1] Lettre du 11 août 1961, du Dr J. B. Wiesner au Dr L. V. Berkner.

SPACE RADIO RESEARCH

I.A.U. Resolutions

(French text : p. 68)

At its final session, on Thursday 24 August 1961, the General Assembly of the International Astronomical Union unanimously adopted two Resolutions concerning possible interference with astronomical observations by certain space projects. I am directed formally to bring these Resolutions to your attention, and to request that you use your utmost endeavour to ensure that all Governments comply with the appeal in the final paragraph of Resolution nº 1. Resolution nº 2, which is concerned with a single specific project, is communicated solely for your information.

The English text of the two Resolutions is given hereunder.

This communication is being addressed to :

(*a*) Governments, either direct, or through a National Academy of Sciences or other appropriate organization ;

(*b*) the United Nations Organization ;

(s) Unesco ;

(*d*) the International Council of Scientific Unions, its component Scientific Unions, and its Special Committees ;

(*e*) the I.T.U., W.M.O. and other Governmental and Non-Governmental International Organizations.

September, 1961.

The General Secretary (D. H. SADLER).

International Astronomical Union
Royal Greenwich Observatory
Herstmonceux Castle
Hailsham, Sussex, England.

RESOLUTION Nº 1

Viewing with great concern the grave danger that some future space projects might seriously interfere with astronomical observations in the optical as well as in the radio domain,

and *believing* that a degree of contamination of space which at the present time would be hardly detectable, might, if long-lived, well be disastrous to future observations with improved techniques,

and *maintaining* that no group has the right to change the Earth's environment in any significant way without full international study and agreement;

the International Astronomical Union *gives* clear warning of the grave moral and material consequences which could stem from a disregard of the future of astronomical progress,

and *appeals* to all Governments concerned with launching space experiments which could possibly affect astronomical research to consult with the International Astronomical Union before undertaking such experiments and to refrain from launching until it is established beyond doubt that no damage will be done to astronomical research.

RESOLUTION N° 2

The International Astronomical Union expresses its appreciation that the plans for Project West Ford have been publicly announced well ahead of proposed launching and of the United States Government's official policy (1) that further launchings will be guided by the principle that such projects shall not be undertaken unless sufficient safeguards have been obtained against harmful interference with astronomical observations.

Nevertheless the International Astronomical Union views with the utmost concern the possibility that the band of dipoles proposed in Project West Ford might be long-lived, and it is completely opposed to the experiment until the question of permanence is clearly settled in published scientific papers with adequate time being allowed for their study. The International Astronomical Union is opposed to any experiment which might hamper future developments in astronomy.

If a short lifetime for the dipoles and the harmless nature of the experiment can be assured, and if Project West Ford is carried out, the International Astronomical Union regards it as essential that the fullest observations of, and experiments on, the properties

(1) Letter of August 11, 1961, from Dr. J. B. Wiesner to Dr. L. V. Berkner.

and behaviour of the band of dipoles be carried out by all possible means. The observations and experiments should be performed and analysed according to the highest scientific standards and with the best equipment available, bearing in mind that signals which are barely, or not, detectable today will probably cause serious interference with future scientific research because of the development of more sensitive equipment.

The observations and experiments to be made on West Ford are likely to be difficult to perform, and will, in many ways, be similar to those carried out by the authorities responsible for operating West Ford. Moreover, much specific information such as precise and up-to-date ephemerides will be required. The International Astronomical Union will attempt to arrange for rapid and full co-operation among astronomers making observations and calculations, and to provide for world-wide dissemination of their results conforming to accepted standards of scientific research.

The International Astronomical Union welcomes the position [1] taken by the Government of the United States that any decision on later experiments of the West Ford type will be taken in the light of the results obtained from the presently proposed experiment. To enable the International Astronomical Union to obtain the necessary data, it requests the Government of the United States to grant full privileges to a group of astronomers, acceptable both to the Government and to the Union, to co-operate with West Ford authorities in performing quantitative experiments to determine the properties of the proposed belt of dipoles, its changes with time and location, and its impact upon present and future astronomical research.

C.O.S.P.A.R.

BIBLIOGRAPHY

N° 6 of the *C.O.S.P.A.R. Information Bulletin* has been issued; it contains 18 reports on national activities submitted to the Fourth Meeting of C.O.S.P.A.R. (Florence, April 1961).

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[1] Letter of August 11, 1961, from Dr. J. B. Wiesner to Dr. L. V. Berkner.

FREQUENCY ALLOCATIONS

Inter-Union Committee for Frequency Allocations for Radio Astronomy and Space Science (I.U.C.A.F.)

List of Documents distributed to members of the I.U.C.A.F.

Doc. I.U.C.A.F./1 : Constitution and Terms of Reference.

Doc. I.U.C.A.F./2 : Preliminary Conclusions.

Doc. I.U.C.A.F./3 : Report to Committee, dated 9th January, 1961.

Doc. I.U.C.A.F./4 : A Survey of the Frequencies Assigned to Radio Astronomy and Space Science in the Radio Regulations, Geneva, 1959.

Doc. I.U.C.A.F./5 : Letter dated 26th January, 1961, covering question R/3 « Service de Radioastronomie », received from the European Conference of Administration of Postal and Telecommunication Services.

Doc. I.U.C.A.F./6 : Committee on Space Research — Statement Prepared for the I.T.U. Ordinary Administrative Radiocommunication Conference, Geneva, 1959.

Doc. I.U.C.A.F./7 : Committee on Space Research — Excerpts from Report of the Ad-hoc Committee on the Peaceful Uses of Outer Space.

Doc. I.U.C.A.F./8 : Report of a Meeting of a Working Party, held at Office of U.R.S.I. in Brussels on 27th-28th March, 1961.

Doc. I.U.C.A.F./9 : Committee on Space Research — Letter to Members of C.O.S.P.A.R. Working Group 1, dated 29th March, 1961.

Doc. I.U.C.A.F./10 : « Radio Astronomy — A Window on the Universe », by J. H. Oort, reprinted from the American Scientist, Vol. 48, June 1960.

Doc. I.U.C.A.F./11 : Report on the Tolerable Level of Interference in the Radio Astronomy Frequency Bands, with letter dated 29th May, 1961.

Doc. I.U.C.A.F./12 : Report on Work of Committee, dated 25th June, 1961.

Doc. I.U.C.A.F./13 : Report on frequency allocations for the Radio Astronomy Service — A statement of position.

Doc. I.U.C.A.F./14 : Four Papers on Project West Ford, reprinted from the *Astronomical Journal*, April 1961.

Doc. I.U.C.A.F./15 : Paper on « The Allocation of Radio Frequencies for Scientific Research », reprinted from the *I.C.S.U. Review*, Vol. 3, 1961.

Doc. I.U.C.A.F./16 : A Summary Report on Project West Ford — from the Space Science Board, National Academy of Sciences, U. S. A.

Doc. I.U.C.A.F./17 : Report on the European Broadcasting Conference, Stockholm, May/June 1961.

Doc. I.U.C.A.F./18 : Progress Report on Work of Committee, dated 30th September, 1961.

Doc. I.U.C.A.F./19 : Paper on « The Allocation of Frequencies for Experiments in Space Communications » by R. L. Smith-Rose, presented at U.R.S.I. Symposium on Space Communication Research — Paris, September, 1961.

MEETING OF WORKING PARTY OF I.U.C.A.F. TO BE HELD AT THE ROYAL SOCIETY, PICCADILLY, LONDON ON WEDNESDAY, 18th OCTOBER, 1961

Agenda

1. Report of the meeting held in Brussels on 27th-28th March, 1961 (Doc. I.U.C.A.F./8).
2. Report on European Broadcasting Conference, Stockholm, May/June, 1961 (Doc. I.U.C.A.F./17).
3. Progress Report on work of the Committee to 30th September, 1961 (Doc. I.U.C.A.F./18).

4. To report the position concerning the Recommendation to the I.T.U., distributed with my letter of 4th September, 1961.
5. Review of Agenda for full committee meetings on 19th and 20th October (to be circulated).
6. To decide future action in connection with protection of frequencies for radio astronomy (Doc. I.U.C.A.F./4).
7. To decide future action in connection with protection of frequencies for space research (Docs. I.U.C.A.F./4 and /19).
8. To draft recommendations relating to 6 and 7, for submission to the meeting of the full committee.
9. To note the definition of « Radio Astronomy », paragraph 74 in I.T.U. Radio Regulations, reproduced on page 2 of Doc. I.U.C.A.F./4 ; and to consider whether any action is required to cover astronomy techniques involving transmission as well as reception.
10. To note the dates of International meetings of interest to the committee (Appendix II of Document I.U.C.A.F./18).
11. Any other business.
12. Date of next meeting of working Group.

24th September, 1961.

R. L. SMITH-ROSE,
Secretary General.

MEETING OF THE I.U.C.A.F. TO BE HELD AT THE ROYAL SOCIETY, PICCADILLY, LONDON, ON THURSDAY 19th AND FRIDAY 20th OCTOBER

Agenda

1. To note the constitution and terms of reference of the Committee (Doc. I. U. C. A. F./1).
2. To welcome as consultants :
   (*a*) Dr. J. H. D. van der Toorn, until recently Director-General of Posts and Telecommunications in the Netherlands.
   (*b*) Mr. A. H. Catá, representing the International Frequency Registration Board (I.F.R.B.) of the International Telecommunication Union (I.T.U.).

3. To note that the work of the Committee was reported to the International Council of Scientific Unions (I.C.S.U.) at its meeting in London during September 1961 ; and that the Union has approved the budget of the Committee for the year 1962, being the same as that for 1961 (Docs. I.U.C.A.F./8 and /12).
4. To note that the Committee is now formally recognised as an active participant in the work of the International Radio Consultative Committee (C.C.I.R.), and the I.T.U. Study Group IV of C.C.I.R. covers Radio Astronomy and Space Science, and the technical problems associated therewith.
5. Consideration of Report of the European Broadcasting Conference held in Stockholm during May/June, 1961 ; and to decide further action to be taken with C.C.I.R. and I.T.U. (Doc. I.U.C.A.F./17).
6. To review the progress of the work of the Committee to date (Doc. I.U.C.A.F./18).
7. To confirm the Recommendation, already provisionally forwarded to the I.T.U. seeking the inclusion of Radio Astronomy and Space Science in the agenda of the Extraordinary Administrative Radio Conference to be held in 1963 (See Doc. I.U.C.A.F./24).
8. To note the definition of « Radio Astronomy », paragraph 74 in I.T.U. Radio Regulations, reproduced on page 2 of Doc. I.U.C.A.F./4 ; and to consider whether any action is required to cover astronomy techniques involving transmission as well as reception.
9. To note the C.C.I.R., Study Group IV will hold an Interim Meeting in Washington in March 1962, and that the latest date for submission of Recommendations is 15th January, 1962.
10. To decide future action, including preparation of appropriate recommendations, in connection with the protection of frequencies for :

    (*a*) radio astronomy, and

    (*b*) space research. (Docs. I.U.C.A.F./4 and /19).

    Any draft recommendations prepared up to the date of the meeting will be placed before the Committee.

11. To supplement the list of Radio Astronomy Observatories given in Appendix III of Doc. I.U.C.A.F./18.
12. To examine in more detail the degree of protection required for the radio astronomy services.
13. Any other business.
14. Date of next meetings.

2nd October, 1961.

R. L. SMITH-ROSE,
Secretary General.

U. S. A. Committee on Radio Frequency Allocations for Scientific Research

News Report, U. S. A. National Academy of Sciences

VOL. XI, N° 4, JULY-AUGUST 1961

In the spring of 1961, the Academy-Research Council established a Committee on Radio Frequency Allocations for Scientific Research to consider and represent the needs of United States science for radio frequency allocations and to serve as the United States counterpart to the Inter-Union Committee on Frequency Allocations for Radio Astronomy and Space Science (I.U.C.A.F.) established by the International Council of Scientific Unions (I.C.S.U.) in the fall of 1960. Membership on the Academy's Committee was appointed from the United States counterparts of the three international bodies represented on the I.C.S.U. Inter-Union Committee : the U. S. National Committees for the International Astronomical Union (I.A.U.) and the International Scientific Radio Union (U.R.S.I.) and the Space Science Board for the I.C.S.U. Committee on Space Research (C.O.S.P.A.R.). Members were also appointed from government organizations concerned with radio frequency allocations in this country.

The Committee has held one meeting on May 3 which was basically organizational in character but considered some special problems addressed to it by Committee members. The Committee, however, is active in representing the needs of United States scien-

tists for radio frequency allocations and much work is currently being carried out by correspondence and liaison.

Perhaps of particular interest and note is the Committee's formal endorsment of a report prepared by the *ad hoc* Committee for Radio Astronomy of the Academy-Research Council. This report was fully developed in draft form prior to organization of the present Committee. After review, the final version was prepared in June 1961.

The present Committee members are :

J. Howard DELLINGER (radio science), *Chairman.*

R. C. PEAVY (space research), *Secretary.*

Allen BARNABEI, National Bureau of Standards.

Robert J. COATES, National Aeronautics and Space Administration.

Leo GOLDBERG, Harvard College Observatory (space research).

Geoffrey KELLER, National Science Foundation.

Robert S. LAWRENCE, National Bureau of Standards, Boulder (Colo.) (radio science).

Wm. H. RADFORD, Lincoln Laboratory, Massachusetts Institute of Technology (Joint Technical Advisory Committee, Institute of Radio Engineers-Electronic Industries Association).

G. C. Mc. VITTIE, University of Illinois (astronomy).

Harlan J. SMITH, Yale University (astronomy).

O. G. VILLARD, Jr., Stanford University (space research).

Ex officio members (US members of IUCAF) ;

Edward F. McCLAIN, U. S. Naval Research Laboratory.

Richard M. EMBERSON, Associated Universities, Inc.

John P. HAGEN, National Aeronautics and Space Administration.

Documentation

Nous attirons l'attention des membres du Comité Inter-Unions pour l'Attribution de Fréquences pour la Radioastronomie et la Science Spatiale, du Comité pour l'Attribution de Fréquences pour des Buts scientifiques et du Comité pour les Recherches Radio-

électriques dans l'Espace sur les articles suivants publiés dans le *Journal des Télécommunications* :

« Le partage des fréquences entre les Services de Communication par satellites et les Radiocommunications de surface », par S. G. LUTZ (Vol. 28, nº 9, Sept. 1961, p. 561) ;

« L'attribution des bandes de fréquences aux services de l'espace », par J. A. WEBB (Vol. 28, nº 10, Oct. 1961, p. 631).

Bibliography

We call the attention of the members of the Inter-Union Committee on Frequency Allocation for Radio Astronomy and Space Science, of the Committee on Frequency Allocation for scientific purposes and of the Committee on Space Radio Research to the following articles published in the *Telecommunication Journal* :

« Frequency Sharing between Satellite Communication and Surface Radio Systems », by S. G. LUTZ (Vol. 28, nº 9, Sept. 1961, p. 585) ;

« Spectral allocation for space communications », by J. A. WEBB (Vol. 28, nº 10, Oct. 1961, p. 651).

ANNÉE GÉOPHYSIQUE INTERNATIONALE

Données Ionosphériques pendant l'A.G.I.

(English text : p. 82)

Le volume XV des *Annals of the International Geophysical Year* vient de paraître. Cet ouvrage fait suite aux volumes XIII et XIV annoncés dans le *Bulletin d'Information*, n° 127, p. 74, et contient les données fournies par les 33 stations suivantes :

Providenie Bay	Singapore	Tortosa
Pruhonice	Slough	Trivandrum
Puerto Rico	Sodankyla	Tromsö
Quetta	Sverdlovsk	Uppsala
Rome	Taipei	Victoria
Rostov	Talara	Wakkanai
Salekhard	Thule	Washington D. C.
Salisbury	Tikhaya Bay	White Sands
San Francisco	Tiruchirapalli	Yakutsk
Schwarzenburg	Tixie Bay	Yamagawa
Simferopol	Tomsk	Yuzhno-Sakhalinsk

Atmosphériques

Nous informons nos lecteurs que vient de paraître, sous les auspices de l'Institut Suisse de Météorologie, un ouvrage intitulé : « Mesures des parasites atmosphériques, d'électricité atmosphérique et de radioactivité de l'air à Murchison Bay (Spitzberg), Payerne et Zurich », par J. Lugeon, A. Junod, P. Wasserfallen et J. Rieker.

INTERNATIONAL GEOPHYSICAL YEAR

Ionospheric Data

(French text : p. 81)

Volume XV of the *Annals of the International Geophysical Year* has been issued. This book continues volumes XIII and XIV announced in the *Information Bulletin*, nº 127, p. 76, and contains data provided by the 33 following stations :

Providenie Bay	Singapore	Tortosa
Pruhonice	Slough	Trivandrum
Puerto Rico	Sodankyla	Tromsö
Quetta	Sverdlovsk	Uppsala
Rome	Taipei	Victoria
Rostov	Talara	Wakkanai
Salekhard	Thule	Washington D. C.
Salisbury	Tikhaya Bay	White Sands
San Francisco	Tiruchirapalli	Yakutsk
Schwarzenburg	Tixie Bay	Yamagawa
Simferopol	Tomsk	Yuzhno-Sakhalinsk

Atmospherics

The attention of the readers is called to the following work published under the auspices of the Institut Suisse de Météorologie : « Mesures des parasites atmosphériques, d'électricité atmosphérique et de radioactivité de l'air à Murchison Bay (Spitzberg), Payerne et Zurich », by J. Lugeon, A. Junod, P. Wasserfallen and J. Rieker.

Report of the Indian National Committee

The Report of the Indian National Committee for the I.G.Y. has been issued. This Report edited by the above Committee (*Secretary* : Dr. A. P. MITRA, National Physical Laboratory, New Delhi 12) besides general *I.G.Y. information* contains fifteen sections devoted to each of the items of the I.G.Y. General Programme.

C. C. I. R.

Nouveaux textes adoptés par correspondance

(English text : p. 87)

I. Postérieurement à la publication de l'Addendum n° 1 aux Volumes I, II et III de la IX^e Assemblée Plénière du C.C.I.R., quatre nouveaux textes ont été soumis en vue de leur adoption par correspondance ; ces textes ont reçu chacun plus que les douze approbations nécessaires pour leur adoption de la part des Membres et Membres associés de l'U.I.T. et ils sont devenus respectivement une Question et trois Programmes d'études du C.C.I.R.

Les textes en question sont :

— « Caractéristiques techniques des systèmes de communication et de navigation utilisant des satellites de la terre ». Ce texte est devenu la Question n° 209 (IV) et le Directeur du C.C.I.R. l'a attribuée à la Commission d'études n° IV.

— « Niveau de brouillage sur la fréquence radiotélégraphique de détresse ». Ce texte est devenu le Programme d'études n° 171 XIII) et le Directeur du C.C.I.R. l'a attribué à la Commission d'études n° XIII.

— « Facteurs influençant la propagation dans les liaisons avec les véhicules de l'espace ».

— « Influences du bruit naturel et du plasma ionosphérique dans les liaisons avec des véhicules de l'espace ».

Ces textes sont devenus respectivement les Programmes d'études n° 172 (IV) et 173 (IV) et le Directeur du C.C.I.R. les a attribués à la Commission d'études n° IV.

Nous donnons ci-après les décisions contenues dans ceux de ces documents qui intéressent l'U.R.S.I.

Question n° 209 (IV). — Le C.C.I.R. décide de mettre à l'étude la question suivante :

1. quels sont les types de systèmes préférés pour les applications suivantes dans le cas de l'utilisation de satellites actifs ou passifs de la terre :

1.1. services fixes de télégraphie et téléphonie multivoie, de télévision et de transmission de données ;

1.2. services mobiles assurant des communications télégraphiques ou téléphoniques et des transmissions de données entre des stations fixes d'une part et des navires, des aéronefs ou des véhicules spatiaux d'autre part ;

1.3. services de navigation (y compris le repérage) ;

2. quelles sont les bandes de fréquences à utiliser de préférence pour ces applications ;

3. serait-il possible de partager ces bandes de fréquences avec d'autres services et, dans l'affirmative, dans quelles conditions ;

4. comment les voies radioélectriques devraient-elles être disposées à l'intérieur des bandes de fréquences préférées pour les applications énumérées au paragraphe 1 ;

5. quelles sont les caractéristiques préférées de bande de base et de modulation pour ces applications ;

6. quelles mesures convient-il de prendre pour l'identification et le contrôle des émissions des systèmes de communication et de navigation utilisant des satellites de la terre ?

Programme d'études nº 172 (IV). — Le C.C.I.R. décide qu'il y a lieu d'effectuer les études suivantes :

1. étudier les paramètres troposphériques et ionosphériques qui peuvent influencer ladite propagation ;

2. effectuer des mesures régulières de ceux de ces paramètres qui sont variables dans le temps ;

3. étudier l'influence des effets Doppler et Faraday ;

4. contrôler les conclusions obtenues à partir des observations systématiques par des expériences appropriées de propagation.

Programme d'études nº 173 (*IV*). — Le C.C.I.R. décide qu'il y a lieu d'effectuer les études suivantes :

1. étudier les conditions de bruit dans l'ionosphère, intérieure et extérieure, et dans l'espace par
   — des études théoriques,
   — des expériences directes ;

2. étudier les influences du plasma environnant sur le fonctionnement des émetteurs et récepteurs de bord par
   — des expériences de laboratoire,
   — des expériences directes.

II. A la suite d'un échange de lettres entre les Rapporteurs principaux des Commissions d'études nº IV et VI et le Directeur du C.C.I.R., et avec l'accord des participants aux travaux de ces deux Commissions d'études, il a été décidé que l'étude des Questions relatives à la radioastronomie serait désormais confiée à la Commission d'études nº IV. Une modification appropriée est à effectuer à la page 91 du Volume II.

C. C. I. R.

New texts adopted by correspondence

(French text : p. 84)

I. Subsequent to the issue of Addendum n° 1 of the volumes of the IX Plenary Assembly, a further four texts have been received from various sources for adoption by correspondence ; more than the statutory minimum of twelve affirmative replies have been received from Members and Associate Members of the I.T.U. in respect of each of these four texts, and in consequence they have become officially a Question and three Study Programmes of the C.C.I.R.

The texts in question are :

— « The technical characteristics of communication and navigation systems using earth satellites ». This has been allotted the serial number Question n° 209 (IV) and the Director has allocated it to Study Group n° IV.

— « Interference level on the radiotelegraph distress frequency ». This has been allotted the serial number Study Programme n° 171 (XIII) and the Director has allocated it to Study Group n° XIII.

— « Factors affecting propagation in communications with space vehicles ».

— « Influence of natural noise and ionospheric plasma on communications with space vehicles ».

These texts have been allotted the serial numbers Study Programmes n° 172 (IV) and 173 (IV) respectively and the Director has allocated them to Study Group n° IV.

We are giving hereunder the decisions contained in those documents of interest to U.R.S.I.

Question n° 209 (IV). — The C.C.I.R. decides that the following question shall be studied :

1. what are the preferred types of system for the following applications, using active or passive earth satellites,

1.1. fixed services for multichannel telegraphy and telephony, television and data transmission ;

1.2. mobile services providing telegraphy, telephony and data transmission between fixed stations and ships, aircraft and vehicles in space ;

1.3. navigational services (including tracking) ;

2. what are the preferred frequency bands for these applications ;

3. would it be possible to share these frequency bands with other services, and if so, under what conditions ;

4. what radio-frequency channel arrangements should be used within the preferred frequency bands for the applications referred to in para. 1 ;

5. what are the preferred baseband and modulation characteristics for these applications ;

6. what arrangements should be made for the identification and control of emissions used in earth satellite communication and navigation systems ?

Study Programme n° 172 (*IV*). — The C.C.I.R. decides that the following studies should be carried out :

1. an investigation into those properties of the troposphere and the ionosphere which may affect this type of propagation ;

2. regular measurements of those parameters which vary with time ;

3. an investigation of the influence of the Doppler and Faraday effects ;

4. a check, by means of suitable propagation experiments, of the results obtained from systematic observations.

Study Programme n° 173 (*IV*). — The C.C.I.R. decides that the following studies should be carried out :

1. an investigation of noise conditions in the inner and outer ionosphere and in space by
   — theoretical studies,
   — direct experiments ;

2. investigation into the influence of the surrounding plasma on the performance of receivers and transmitters on board by
   — experiments in the laboratory,
   — direct experiments.

II. Following an exchange of letters between the Chairmen of Study Groups IV and VI and the Director of the C.C.I.R., and with the agreement of the participants in the work of both these Study Groups, it was decided that the study of all questions concerning radioastronomy will, in future, be allocated to Study Group nº IV. A suitable modification may be made to page 91 of Volume II.

BIBLIOGRAPHIE

(English text : p. 91)

Union Internationale des Télécommunications

L'Union Internationale des Télécommunications a publié les ouvrages ci-après :

— Répertoire des définitions des termes essentiels utilisés dans le domaine des télécommunications :
Partie I. — Termes généraux, Téléphonie, Télégraphie
1er Supplément à la Partie I.

Commission Electrotechnique Internationale

Publication 64. *Troisième édition.* — Lampes à filament de tungstène pour l'éclairage général.

Prix : Fr. S. 15.— plus frais de port.

Publication 134. *Première édition.* — Systèmes de valeurs limites pour les tubes électroniques et les dispositifs à semi-conducteurs analogues.

Prix : Fr. S. 3.— plus frais de port.

Publication 135. *Première édition.* — Numérotation des électrodes et désignation des sections des tubes électroniques.

Prix : Fr. S. 3.— plus frais de port.

Publication 128. *Première édition.* — Code international pour le marquage des lampes de projections photographiques.

Prix : Fr. S. 6.— plus frais de port.

Publication 50 (62). *Deuxième édition.* — Vocabulaire Electrotechnique International, Groupe 62 : Guides d'ondes.

Prix : Fr. S. 8.— plus frais de port.

Publication 125. *Première édition.* — Classification générale des matériaux en oxydes ferromagnétiques et définition des termes. Cette publication contient d'une part une classification des matériaux en question et vise d'autre part à l'uniformisation des termes et des définitions d'emploi général dans le domaine des pièces et matériaux en oxydes ferromagnétiques. Elle contient une quarantaine de termes accompagnés de leurs définitions répartis entre cinq sections : Perméabilité, Pertes, Variabilité, Magnétostriction, Résistivité.

Prix : Fr. S. 9.— plus frais de port.

Ces publications sont en vente au Bureau Central de la C.E.I., 1, rue de Varembé, Genève.

BIBLIOGRAPHY

International Telecommunication Union

The International Telecommunication Union has issued the following publications :

— List of definitions of essential telecommunications terms :

Part I. — General terms, Telephony, Telegraphy ;

First Supplement to Part I.

International Electrotechnical Commission

Publication 64. *Third edition.* — Tungsten filament lamps for general service.

Price : Sw. Fr. 15.— plus postage.

Publication 134. *First edition.* — Rating systems for electronic tubes and valves and analogous semiconductor devices.

Price : Sw. Fr. 3.— plus postage.

Publication 135. *First edition.* — Numbering of electrodes and designation of units in electronic tubes and valves.

Price : Sw. Fr. 3.— plus postage.

Publication 128. *First edition.* — International code for the designation of photographic projector lamps.

Price : Sw. Fr. 6.— plus postage.

Publication 50(62). *Second edition.* — International Electrotechnical Vocabulary, Group 62 : Waveguides.

Price : Sw. Fr. 8.— plus postage.

Publication 125. *First edition.* — General classification of ferromagnetic oxide materials and definitions of terms. This publication, in addition to containing a classification of such materials, lays down uniform terms and definitions for general use in the field of ferromagnetic oxide parts and materials. It contains some 40 terms and definitions, divided into five sections : Permeability, Losses, Variability, Magnetostriction, Resistivity.

Price : Sw. Fr. 9.— plus postage.

These publications are on sale at the Central Office of the I.E.C., 1, rue de Varembé, Geneva.